APPENDIX C

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

A STREAM RESTORATION PLAN FOR A PROPOSED SURFACE MINE NEAR SUGAR BRANCH, KNOTT COUNTY, KENTUCKY (APPLICATION No. 860-0380, A. No. 6)

Prepared for:
Logos Engineering, Inc.
Manchester, Kentucky
&
Nally & Hamilton Enterprises, Inc.
Bardstown, Kentucky

Prepared by:
Joel Beverly

Apogee Environmental Consultants, Inc.
P.O. Box 338
Ermine, KY 41815
PHONE: (606) 633-7677
FAX: (606) 632-2626

Apogee Project # 05-104.00

March 2006

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Letter of Transmittal

Attention:
Mr. Darvin Messer
USACE
845 Sassafras Creek Road
Sassafras, KY 41759-8806

DATE	PROJECT #	DELIVERED VIA:	SUBMITTED BY:	RECEIVED BY:
7/12/06	05-104.00	Hand	Joel Beverly	

QTY.	DESCRIPTION
6	A STREAM RESTORATION PLAN FOR A PROPOSED SURFACE MINE NEAR SUGAR BRANCH, KNOTT COUNTY, KENTUCKY (APPLICATION No. 860-0380, A. No. 6)

Dear Mr. Messer,

Please find enclosed a stream restoration plan for a proposed surface mine near Redfox, Knott County, Kentucky (Application No. 860-0380, A. No.1). The applicant (Nally & Hamilton Enterprises, Inc.) requests that this plan be considered by the USACE for a Nationwide 21 Permit. If you should have any questions or comments concerning this project, please feel free to contact me at my office.

Sincerely,

Joel Beverly
Director of Environmental Services

CC: Mr. Rusty Roberts, Logos Engineering, Inc. (Letter of Transmittal)
Mr. Les Williams, Nally & Hamilton Enterprises, Inc. (1 copy)
File (1 copy)

TABLE OF CONTENTS

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

LIST OF TABLES

LIST OF FIGURES

APPENDICES

APPENDIX A: Completed High Gradient Stream Data Sheets
APPENDIX B: Stratum Rank Key
APPENDIX C: Completed Data Sheets for Longitudinal Profiles, Pebble Counts, and Cross Sections
APPENDIX D: Longitudinal Profile, Cross Sections, and Pebble Counts for Streams to be Disturbed at Proposed Project
APPENDIX E: Longitudinal Profile, Cross Sections, and Pebble Counts for Five to Seven Percent Grade Stream
APPENDIX F: Stream Compensation Ratio Calculator Forms
APPENDIX G: EII Calculation Spreadsheets for Pre-disturbance
APPENDIX H: EII Calculation Five Years after Disturbance
APPENDIX I: EII Calculation for 30 Years after Disturbance

ATTACHMENTS

ATTACHMENT 1: J-hook Diagram
ATTACHMENT 2: Log Vane Diagram
ATTACHMENT 3: Rock Vane Diagram
ATTACHMENT 4: Step Pool Diagram

1.0 INTRODUCTION

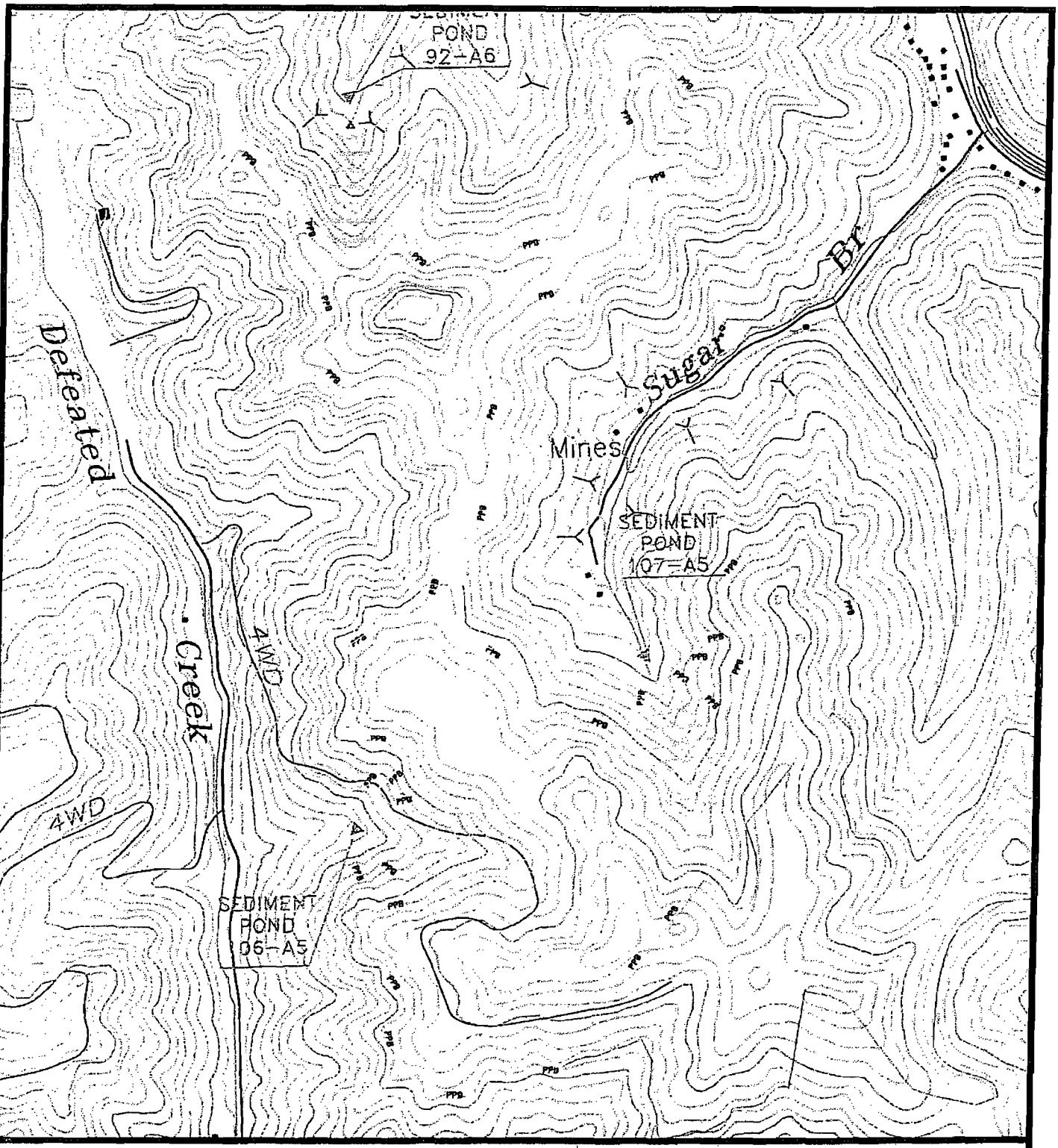
Apogee Environmental Consultants (Apogee) was contracted by Logos Engineering, Inc. to prepare a post-mining stream restoration plan for three streams in Knott County, Kentucky. The proposed mine by Nally & Hamilton Enterprises, Inc. [Department of Natural Resources (DNR) Permit No. 860-0380, A. No. 6] and the associated streams to be disturbed are shown in Figure 1. This plan is hereby submitted to U. S. Army Corps of Engineers (USACE) on behalf of Logos Engineering, Inc. and Nally & Hamilton Enterprises, Inc to fulfill the requirements set forth by USACE concerning Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

2.0 SITE LOCATION AND DESCRIPTION

The project area is located in Knott County, Kentucky, approximately 1.0 miles southwest of the community of Redfox (Figure 1). The proposed permit area, which is situated on the ridges, slopes and hollows, between Sugar Branch and Defeated Creek, covers approximately 214.5 surface acres. There will be three hollow fills (hollowfills No. 15, 16, and 17) and three associated sediment control ponds (sediment ponds 106, 107, and 92) for the proposed permit that will impact waters of the United States. Hollowfill No. 15 and sediment control pond No. 106 are located in an Unnamed Tributary to Defeated Creek, Hollowfill No. 16 and sediment control pond No. 107 are located in the headwaters of Sugar Branch, and Hollowfill No. 17 and sediment control pond No. 92 are located in the headwaters of and unnamed tributary to Carr Creek Lake. Defeated Creek also flows into Carr Fork Lake while Sugar Branch flows into Breeding Creek. All three affected stream sections are small (1st order) and are located within the North Fork Kentucky River drainage system. All three affected stream sections have intermittent and ephemeral sections.

2.1 Direct and Indirect Impacts

Hollow fill No. 15 will impact 1,729 feet of stream while Sediment Structure No. 106 will impact 112 feet of stream. Hollow fill No. 16 will impact 1,839 feet of stream while Sediment Structure No. 107 will impact 135 feet of stream. Hollow fill No. 17 will impact 684 feet of stream while Sediment Structure No. 92 will impact 105 feet of stream. It is expected that approximately 0.53 acres of waters of the U.S. will be impacted during project operations. The drainage areas above



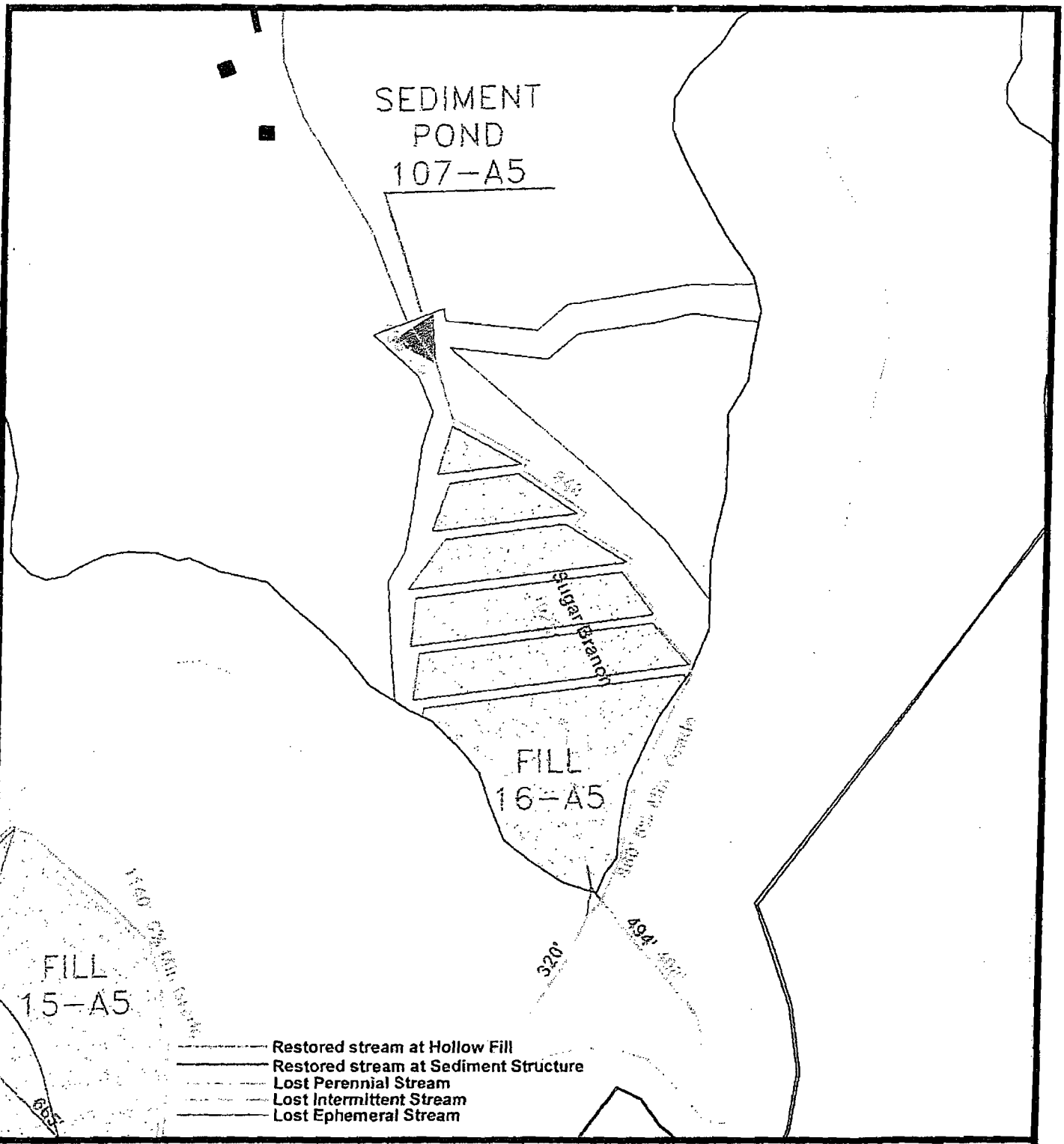
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626

NALLY & HAMILTON ENTERPRISES

Figure 1. Proposed Surface Mine, Hollowfill, Pond, and Biological Assessment Sites.

SCALE:	1"=1000'	1/11/06



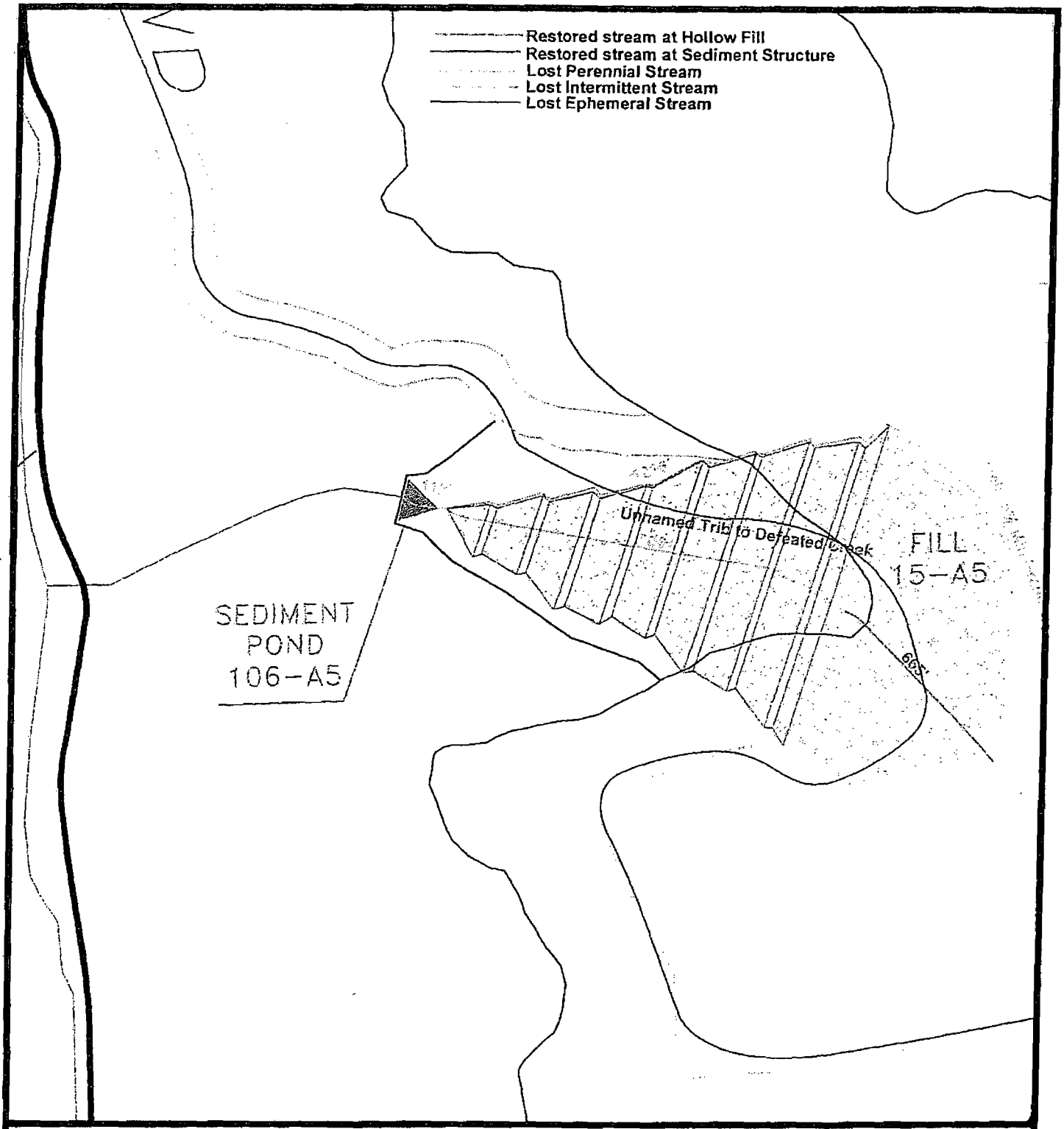
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626

NALLY & HAMILTON ENTERPRISES, INC.

Figure 2. Restored Stream Areas for Mitigation at Fill 107-A5, Sediment Pond 107-A5, and stream reach between them, Knott County, Kentucky.

SCALE:	1"=300'	11/15/05



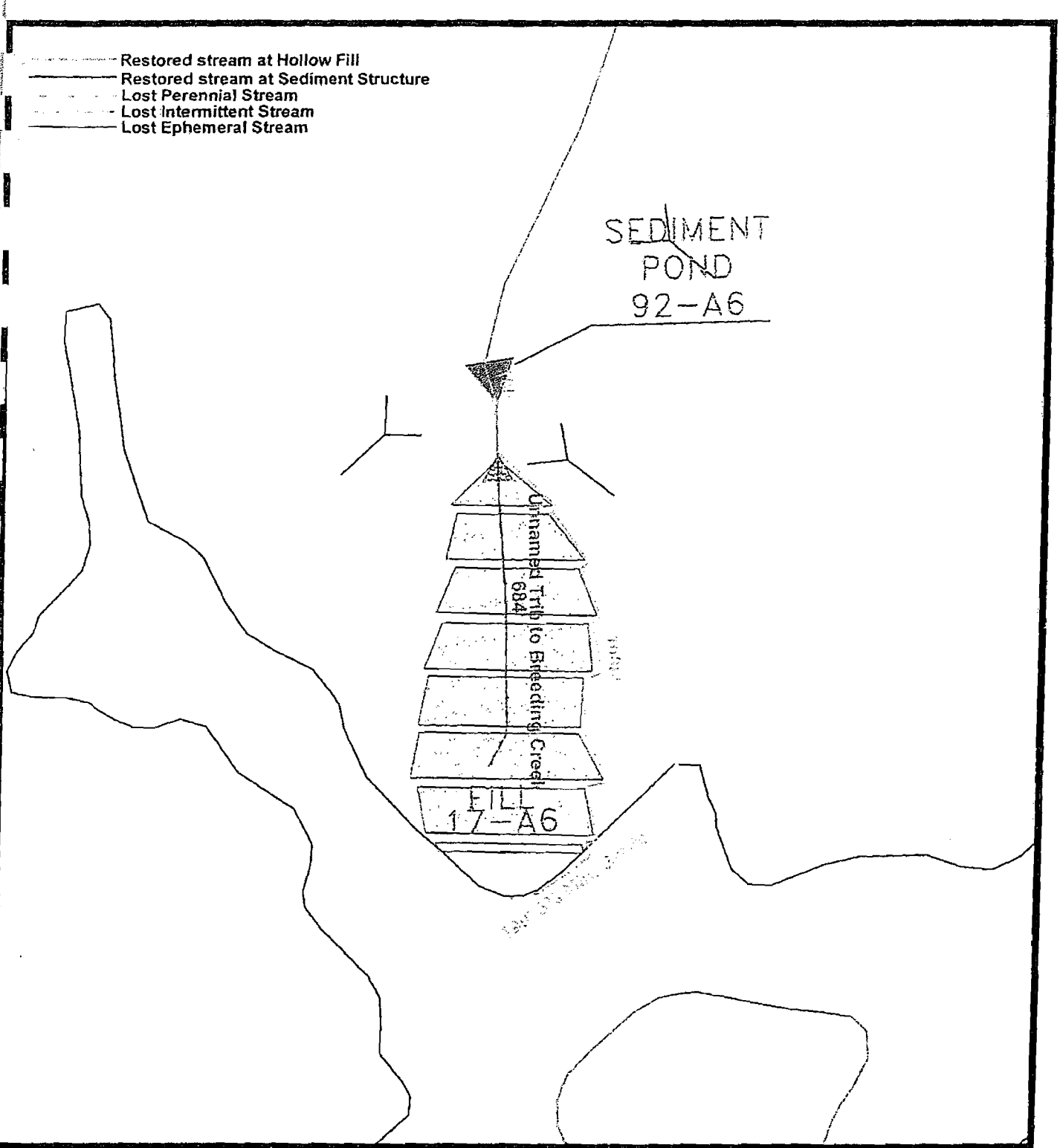
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Figure 3. Restored Stream Areas for Mitigation at Fill 15-A5, Sediment Pond 106-A5, and stream reach between them, Knott County, Kentucky.

SCALE:	1"=300'	11/15/05



APOGEE
ENVIRONMENTAL CONSULTANTS, INC.
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Figure 4. Restored Stream Areas for Mitigation at Fill 17-A6, Sediment Pond 92-A6, and stream reach between them, Knott County, Kentucky.

SCALE:	1"=300'	1/11/06

the toe of hollowfills No. 15, 16, and 17 are 67, 64, and 33 acres respectively. The drainage areas above the dams of sediment structures No. 106, 107, and 92 are 69.8, 66.5, and 35.9 acres respectively. Approximately 1,245,596, 1,243,772, and 1,868,113 cubic yards of fill material will be placed into hollowfills No. 15, 16, and 17 respectively. There will be no impacts to wetlands during the proposed mine project. Direct impacts are illustrated in Figures 2, 3, and 4. No indirect impacts are planned for the project.

Features which might create adverse surface water conditions are existing roads, previous logging operations, existing gas wells, and previous mining operations. No other conditions are known to exist in the watershed which may create any adverse surface water conditions. With the exception the above disturbances, the drainages are completely forested. The proposed project area is located on the Blackey USGS quadrangle.

2.2 Physiography

The project area is situated in the Dissected Appalachian Plateau Ecoregion (Woods et al. 2002). The ecoregion is characterized by narrow ridges, deep coves, narrow valleys, and a mostly forested landscape. Forest types in this ecoregion consist of mixed mesophytic in coves and on north- and east-facing slopes, and mixed oak forests in more upland situations and south- and west-facing lower slopes. White oak forests are also common. Overall, forest composition is highly variable, influenced by such factors as aspect, previous land usage, and degree of slope and topographical shading. Many streams in this ecoregion are cool and high gradient; with a substrate commonly consisting of cobble and boulder (riffles are common). The underlying geology consists of Pennsylvanian shale, siltstone, sandstone, and coal. The presence of coal mining (and also logging and gas exploration) has led to many streams being degraded. Nutrient levels in streams are low, a result of the areas low population, limited farming, and non-carbonate rocks.

2.3 Purpose of Project

2.3.1 Method of Operation

This application proposes surface mining of the area shown on the attached maps. Mining is expected to begin within two months of the final issuance of the permit.

Removal of overburden and coal will be conducted by conventional surface mining methods. Equipment utilized will consist primarily of drills, dozers, loaders, and trucks. Drills (RDC-16) will assist in the blasting of material, with dozers (155 KOMATSU) and loaders (988 CAT) moving the overburden. Trucks (769 CAT) will be used if necessary to transport material to storage areas.

Initially, organic material will be removed before topsoil can be stockpiled. All trees and brush will be windrowed on the solid berm. Since small underbrush, weeds, grasses, and a few small trees are the only forms of organic matter present, non-woody organic matter may be mixed with overburden materials where no stability problems will be created.

All topsoil will be removed and stockpiled or immediately redistributed on a regarded area. Complete procedures for handling topsoil are described in the topsoil handling plan. If topsoil is not redistributed within thirty days, the stockpile will be seeded to prevent erosion, etc.

Once topsoil has been removed from a site, overburden removal will begin. As stated previously, loaders, trucks, and dozers will transport material from the coal removal pit. Coal will then be removed following overburden removal. Coal removal from each pit should not exceed two weeks under normal conditions. However, variables such as weather and equipment breakdowns may cause additional delays. In no case will the highwall created from each individual pit be left unreclaimed for more than 60 days from initial disturbance.

Backfilling will be an automatic process. After coal has been removed from the pit area, overburden from the next proposed coal extraction point will be transported to reclaim behind the preceding operation. This operation proposes to have multiple pits (5 maximum) open simultaneously to allow coal haulage on a continuous basis. However, no more than 1500' of total collective highwall will be exposed at any one time. This is necessary to fulfill contract obligations with the purchaser. However, coal removal in a given location shall be completed within sixty (60) calendar days after the initial surface disturbance at that location. Backfilling and grading to approximate original contour shall follow coal removal by not more than sixty (60) days and by not more than 1500 linear feet. Final grading will ensure that all highwalls are eliminated. The area will be compacted by several passes on each layer with the use of heavy equipment.

Following final grading of slopes, topsoil will be reapplied. Care will be taken to prevent compaction of this material. The area will then be seeded and mulched according to the revegetation plan. Any eroded gullies will be regraded, reseeded, and stabilized or rip-rapped.

2.3.2 Bench Pond Construction

Bench ponds will be constructed per enclosed designs at locations shown on the MRP map. However, bench ponds will not be constructed until mining has progressed through the pond location and any coal within the pond location is removed. Prior to pond construction, mining on the bench in a particular watershed will contain all the water in the pit until the pond area has been mined through and the pond constructed. Since the size of the pit will exceed the pond

size, water holding capacities will exceed those of the pond, thereby, providing adequate sediment control. In no case will runoff be allowed to leave the permitted area without first passing through a certified sediment facility. Bench ponds will be built on lowest coal seam to be mined.

2.3.3 Drainage Corridors

Drainage corridors will be permitted between the mining/storage area and the sediment pond proposed. As shown on the enlarged MRP map, the corridor will include the drainage channel and on area adjacent to the channel for access. Total width is proposed at 30 feet. This includes approximately 10 feet for the drainage channel and areas adjacent to it for any mitigation that might arise, and 20 feet to allow equipment access. However, damage to drainage ways is not expected if design plans within the application are followed.

2.3.4 Best Management Practices

This proposed operation intends to use the best management practices available to ensure protection of the lower lying streams and the associated areas. Erosion will be minimized by immediate seeding, mulching and revegetating of disturbed areas including ponds and outslopes. Hay checks will be placed in areas where erosion gullies or concentrated flows may occur. During pond construction, hay checks will be placed below the disturbance to filter initial disturbance runoff. Likewise, hay checks will be used if necessary along roadway ditches or any temporary ditches or drainage channels created. Rip-rap will be used when velocities or volume of runoff dictates. Throughout the mining process, care will be taken to minimize erosion and protect surface and groundwater quantity and quality. Measures will be taken, as conditions dictated, to prevent adverse effects to the area.

2.4 Project Timeline

Mining will begin immediately or very soon after approval is received from the USACE. The life of each mine permit will vary depending on the amount of coal that can be economically mined from each permit. Economic mineability will depend upon the sales price of coal and, thus, a definite length of mining is hard to define. Despite the unknowns, mining operations are expected to last for approximately 3 years.

3.0 SURVEYS CONDUCTED

Several site visits by personnel from Apogee have been made to determine the existing conditions at the three streams that will be impacted during mine operations. This information will guide restoration efforts and will be used to determine if these efforts are a success.

3.1 Aquatic Biological Assessment

The two unnamed tributaries were visited on 10 November 2005 to conduct an aquatic biological assessment. However, due to the streams flowing at such a low level, benthic sampling was not conducted.

3.1.1 Habitat Assessment

The method used to analyze habitat followed Rapid Bioassessment Protocols for use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish (2nd Edition) (Barbour et al. 1999). Sample sites were visited on 2 and 14 December 2005 and 8 January 2006 by Apogee biologists, with stream conditions and riparian vegetation being recorded at each site. Stream conditions at each site were assessed using the High Gradient Stream Data Sheet (Barbour et al. 1999). The following stream condition parameters were assessed at each site: available cover, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles (or bends), bank stability, vegetative protection, and riparian vegetative zone width. The completed data sheets for each site can be found in Appendix A. Riparian vegetation was analyzed using DSMRE's constructed vegetative stratum rank system (Appendix B). Results of the vegetation survey are shown in Table 1.

Table 1. Vegetation analysis using DSMRE's Constructed Vegetative Stratum Rank System at three streams in Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Common Name	Latin Name	HF #15 and SS #106	HF #16 and SS #107	HF #17 and SS #92
Tulip Tree	*Liriodendron tulipifera*	5	6	7
Eastern Hemlock	*Tsuga canadensis*	8		
Sycamore	*Platanus occidentalis*	5		1
Umbrella Magnolia	*Magnolia tripettala*	1	2	1
Sweet Birch	*Betula lenta*	2		2
Black Gum	*Nyssa sylvatica*	2	4	
Beech	*Fagus grandifolia*	4	6	5
Flowering Dogwood	*Cornus floridus*	1		1
Basswood	*Tilia Americana*	1	1	2
Service Berry	*Amalanchier arborescens*	2		
Black Oak	*Quercus velutina*		7	
Sugar Maple	*Acer saccharum*		4	2
Red Maple	*Acer rubrum*		4	

Common Name	Latin Name	HF #15 and SS #106	HF #16 and SS #107	HF #17 and SS #92
Cucumber Tree	*Magnolia accuminata*		1	
Shagbark Hickory	*Carya ovata*		4	
Black Locust	*Robinia pseudoacacia*			1
Sourwood	*Oxydendron arboreum*			2
Yellow Buckeye	*Aesculus flavus*			3
Spice Bush	*Lindera benzoin*			1
Hydrangea	*Hydrangea arborescens*			1

3.1.2 Physiochemical

Measurements were taken for specific conductance during the 2 and 14 December 2005 and 8 January 2006 site visits. Conductivity levels for hollowfills No. 15, 16, and 17 were 410, 270, and 368 respectively.

3.2 Physical Characteristics

Based upon Rosgren's (1994) classification system, stream sections at hollowfills 15, 16, and 17 are considered A3a+, while the stream sections at sediment structure 106, 107, and 92 are considered A3. Both stream types are characterized by having high entrenchment, high gradient (>10 % slope for A3a+ streams and between 4 and 10 % slope for A3 streams), low sinuosity, and a substrate consisting mostly of cobble. The areas of stream to be impacted were assessed using the High Gradient Stream Data Sheet. The streams were in poor condition and thus scored very low (Appendix A). Based upon the streams being in such poor condition, a stream of similar size, but in better condition, was surveyed to get stream pattern, profile, and dimensions to help guide stream restoration efforts. The results of this assessment are located in Table 2. The completed data sheets for longitudinal profiles, pebble counts, and cross sections are located in Appendix C. Longitudinal profiles, cross sections, and pebble counts were also surveyed at all proposed disturbed streams to show current conditions (Appendix D).

Table 2. Stream pattern, profile, and dimension data at unnamed tributary to Carr Creek Lake that will be used to guide restoration efforts at three streams in Knott County, Kentucky.

Characteristic	Score	
	HF Areas	Pond Areas
Pattern		
Sinuosity	1.22	1.17
Profile		
Slope	20.9	10.2
Dimension		
Bankful Width (ft)	5.9	8.0
Mean Depth (ft)	Dry	.3
Maximum Depth (ft)	Dry	1.8
Bankful Depth (ft)	1.5	.85
Width/depth Ratio	3.9	9.4
Floodprone width (ft)	9.3	12.6
Entrenchment Ratio	1.6	1.6

4.0 IMPACTS TO STREAM

4.1 Alternatives Analysis

To ensure that as little stream as possible is impacted, a number of changes have been made to the original engineering plans. Plans had originally called for the construction of sediment ponds farther downstream from each hollowfill. However, after discussing these plans, the client decided to move the sediment control structures as close as practical to the toe of the hollow fills.

To completely ensure that the client is taking the appropriate action concerning waters of the U.S., other options were also considered. Using deep mines instead of area and auger mining techniques were considered. However, deep mining would result in limited resource recovery and would not discourage potential future mining in the same area. Also, due to the area being previously affected by pre-law mining, current proposed activities will remove high wall areas and restore the topography to a more natural slope.

Other options considered included the possibility of using upland areas for the storage of waste materials and also using only two hollowfills. However, both of these alternatives were not viable due to the amount of excess material to be disposed of. Due to the large amount of waste material, it is not practical to

place this material in upland areas. Optimally, this amount of fill could be placed in two hollowfills, however, if only two hollowfill were used, this would lead to more fill being placed into intermittent streams than is proposed in the current work plan. In addition, the three streams that will have hollowfills located in them have been heavily disturbed by past mining. Based upon this, it was not thought that using these streams would greatly impact overall water quality in the area.

Therefore, three hollowfills are proposed, one each on the three stream sections to be disturbed during mining activities. Neither of the streams to be impacted is considered to be a high quality stream, as indicated by the above surveys conducted. Before disturbance is to begin upstream, Ponds 106, 107, and 92 will be constructed to provide sediment control measures for each of the drainages.

4.2 Stream Assessment

The streams were assessed using the Ecological Integrity Index (EII) and Ecological Integrity Units (EIUs) developed by USACE (Table 3). EII is measured as quality per running foot and is scored from 0 – 1 (with 1 being equal to least disturbed conditions in the region). Ecological Integrity Units are calculated by multiplying the EII by length of stream to be impacted (in feet) (Table 1).

Table 3. Stream lengths, Ecological Integrity Index (EII), and Ecological Integrity Units (EIUs) at three streams in Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Impact Reach Name	Stream Length (ft)	EII	EIU
Hollowfill #15 (ephemeral)	665	.20	133
Hollowfill #15 (intermittent)	1,064	.20	212.8
SS #106 (intermittent)	112	.20	22.4
Hollowfill #16 (ephemeral)	814	.38	309.3
Hollowfill #16 (intermittent)	1,025	.38	389.5
SS #107 (intermittent)	135	.39	52.7
Hollowfill #17 (ephemeral)	684	.25	171
SS #92 (intermittent)	105	.25	26.3
Total	**4,604**		**1,317**

4.3 Cumulative Impacts Analysis

In addition to the proposed direct affects on the streams, the incremental impact of the proposed activities when added to other past, present and reasonably foreseeable future actions were also taken into account. Future land disturbances that could potentially occur in the drainages include logging operations and powerline corridor development. It is unlikely that there will be any agricultural development or road construction, due to the hollows being so small, steep, and remote. It is also unlikely that additional mining activities will occur in the drainage after current proposed activities are concluded.

In addition to the above potential future land disturbance activities, there will also be some watershed improvement projects. The proposed streams that will be affected during this project have been heavily impacted by past mining. Past mining areas that are located below the toe of the proposed hollowfills will be restored as closely as possible to a healthy stream system. In addition to the stream sections below the toe of the hollow fill, natural stream sections will also be constructed on both sides of each hollowfill.

5.0 STREAM RESTORATION PLAN

Once all mining activities are completed, the streams will be restored as closely as possible to a healthy stream system. All three streams to be impacted are of very low quality, and thus are not a good guide to restoring the streams. Therefore, a similar size, higher quality stream was surveyed. The results of this survey will guide restoration efforts.

The purpose of this restoration plan is to return stability and ecological function to the impacted streams, while also making the streams self-maintaining. The pattern, profile, and dimension data collected at the high quality stream site will be used to guide the stream restoration efforts. Restoration measures to be employed include stream shaping and realignment, revetments (riffles, boulder clusters; substrate, cover logs, J-hook vanes, and cross vanes), and bioengineering (revegetation).

All sediment control ponds will be removed and each stream restored to a self-maintaining system, while hollowfills will have natural channels constructed on the sides of each (Figures 2, 3, and 4). During the removal of the sediment control ponds, silt fences and/or rows of straw will be employed to reduce the amounts of sediment that will impact the downstream areas. All stream restoration efforts will be conducted during low flow situations.

5.1 Stream Habitat

Current in-stream habitat is not in a natural, self-maintaining condition. All three streams have been impacted by previous mining and logging operations. The streams at proposed hollowfills No. 15 and 17 have old sediment control structures located in them (proposed sediment control structures will be located in the same spot as existing sediment structures) while the stream at proposed hollowfill No. 16 has been heavily affected my logging. Due to these disturbances, we surveyed a more natural, similar size stream located off-site to guide restoration efforts.

During restoration efforts, in-stream habitat will be re-created as closely as possible to a natural stream channel (following data collected at the off-site stream). This will include reproducing as closely as possible the bankfull width, depth, channel sinuosity, riffle-run-pool ratio, and substrate types. The longitudinal profile (riffle/run/pool), cross sections, and pebble count data collected will be used to guide restoration efforts. A diverse in stream habitat will be achieved by using rock/log deflectors, riffles, boulder clusters, substrate (cobble and gravel), cover logs, J-hook vanes (made of large rock, logs, and/or root wads), and cross vanes (rock and log). These structures will help make the stream self-maintaining and also provide a diverse habitat for aquatic organisms. During the construction phase, data sheets detailing current conditions should be referred to to ensure that restoration efforts are being created as closely as possible to pre-disturbance conditions.

In stream restoration structures will be placed in such a way to create a self-maintaining stream. Where bends in the stream are proposed, J-hook vanes will be placed to stabilize the banks and to form a scour pool in the center portion of the channel (Attachment 1). Placing the J-hook vanes in the stream bends will help dissipate energy during high flow situations. The vane arm sections of the J-hook vanes (near the bank) will be interlocked with no spaces in between, thus stabilizing the banks as much as possible. These structures should be built at a 20 to 30 degree angle from the bank. The center sections of the J-hook vanes (that jut out into the middle of the stream) will have gaps located in between the large rocks. These gaps will help transport sediment and improve channel capacity and sediment competence. The vane arm section of the J-hook should be one-third the bankful width of the stream channel and the center section should cover another one-third. Footers for these structures should be three times the protrusion height of the invert rock.

Where sections of the stream are currently straight, cross-vanes will be placed to help provide pool/run habitat. These structures will decrease stream velocity and power near the bank and increase it near the center. Cross vanes will be constructed of either logs or boulders (Attachment 2 and 3). Logs used for these cross vanes will have a 12 to 18 inch diameter and will be at least 18 feet long.

To ensure that the logs will not be washed out during high flow situations, log ends will be buried at least two feet within each bank. Cross vanes constructed of boulders will have footers that are three times the protrusion height of the invert rock. The arm vane arm structures should be built at a 20 to 30 degree angle from the bank. Bankfull levels will be approximately six inches above cross vane structures. These structures will be constructed approximately five to seven bankfull widths of each other.

In areas that are currently occupied by step pools, interlocking cross-vanes will be placed to mimic as closely as possible the pre-disturbance conditions (Attachment 4). These structures will also help dissipate energy during high flow situations and will provide small pockets of deep water habitat for aquatic organisms.

In addition to the stream sections below the toe of the hollow fill, natural stream sections will also be constructed on both sides of each hollowfill. The sides of these drainages will be rip-rapped while the inside sections will have a natural stream channel design. Although there will be drainages down both sides of the hollowfills, the flow of water will be concentrated into only one of these stream sections as to ensure the highest water flow throughout the year. These restored sections will be constructed on solid ground near where the hollow fill comes in contact with the natural terrain. This will help ensure that water does not sink into the fill area but instead flows above ground. In addition, the tree line should come very close to the side of each hollow fill and help to create a more natural setting more quickly. Cross-vanes (made of logs) will be placed in these sections of restored stream to help provide pool/run habitat and to help create a system that is self-maintaining.

In addition to the above listed restoration methods, the restoration will utilize small boulders, cobble, and gravel to mimic as closely as possible the current conditions of the healthy stream. These will help give the stream a natural look and will provide habitat for aquatic organisms. Rock used for the restoration efforts will be a durable sandstone obtained on-site during project operations.

5.2 Riparian Habitat

Once the stream restoration efforts are complete, the riparian vegetation will be re-established. This riparian vegetation will help prevent sedimentation of the streams, keep water temperatures cool (by shading), and provide nutrients for organisms that live within the stream. Mesic-hydric and hydric shrubs will be planted between the normal flow and bankfull areas. This riparian zone will be 60 feet wide on both sides of the stream. During the revegetation process, the site will have hydromulch applied. The hydromulch will aid in the retention of water and help prevent the site from becoming excessively dry. As this mulch decays it will also build additional topsoil.

5.2.1 Grasses

The site will be seeded with temporary groundcover, legumes and permanent grass. The temporary plants to be seeded will include either foxtail millet (*Setaria italica*), annual rye (*Lolium multiflorum*), or winter cereal rye (*Secale careale*). To insure seeding and to diversify the temporary vegetation, a combination of these species may be used. During seeding a species of legume [white clover (*Trifolium repens*)] will be selected to achieve nitrogen fixation in the soil and to provide quick growing ground cover. In addition to temporary plants and legumes, two species of permanent grasses will be seeded to help build topsoil and to provide quick soil cover. The grasses to be seeded will be a combination of little blue stem (*Schizachyrium scoparium*); redtop (*Agrostis alba*), and little blue stem; or orchard grass, redtop, and little blue stem. See Table 4 for seeding rates for the grasses, legumes, and temporary plants.

Table 4. Seeding rates for grasses, legumes, and temporary plants at proposed permit area, Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Types of Plants and Common Name	Rate per Acre
Permanent Grass	
Redtop Grass	3 lbs
Little Blue Stem	3 lbs
Legume	
White clover	3-5 lbs
Temporary Plants	
Foxtail Millet	5-10 lbs
Annual Rye	15-20 lbs
Winter Cereal Rye	15-20 lbs

5.2.2 Trees

Native species of trees that are currently known from the site should be used whenever they are available from the Kentucky Division of Forestry and Nurseries. The exact species of trees to be used will be determined at a later time and will depend on availability. However, at least three species each of trees and shrubs should be used to revegetate the riparian areas. A total of 500 stems per acre will be planted as part of the revegetation plan (350 trees and 150 shrubs). Revegetation will be considered a success if after five years there are 300 stems per acre of live trees and shrubs (200 trees and 100 shrubs). Both trees and shrubs should be planted between three and six feet from each other. This will help ensure that enough vegetation is planted to get the benefits of the riparian habitat, without the vegetation being too densely packed. Trees planted will be bare root stock. In addition to planted species, the site will probably have some native volunteer species invade. Table 5 lists recommended tree species for revegetation of the riparian areas.

Table 5. Recommended tree species for revegetation of riparian areas, Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Common Name	Scientific Name	Hydrologic Regime
Tree Species		
Silver Maple	*Acer saccharinum*	Mesic
Sugar Maple*	*Acer saccharum*	Intermediate Mesi/Xeric
Yellow Birch	*Betula alleghaniensis*	Mesic
Sweet Birch*	*Betula lenta*	Mesic
Tulip Tree*	*Liriodendron tulipifera*	Mesic
Sweet Gum	*Liquidambar styraciflua*	Hydric
Sycamore*	*Platanus occidentalis*	Mesic-Hydric
Basswood*	*Tilia americana*	Mesic
Northern Red Oak	*Quercus rubra*	Mesic
American Elm	*Ulmus americana*	Mesic-Hydric
Red Elm	*Ulmus rubra*	Mesic-Hydric
Eastern Hemlock*	*Tsuga canadensis*	Mesic
Shrub Species		
Alder	*Alnus serrulata*	Hydric
Black Willow*	*Salix nigra*	Hydric
Elderberry	*Sambucus Canadensis*	Mesic-Hydric
Ironwood	*Carpinus caroliniana*	Mesic-Hydric
Maple-leaved Vibernum	*Vibernum acerfolia*	Mesic
Witch Hazel	*Hamamelis virginiana*	Mesic
Hydrangea *	*Hydrangea arborescens*	Mesic-Hydric
Spicebush*	*Lindera benzoin*	Mesic

• = Tree and shrub species that are currently growing on the permit area.

6.0 MITIGATION

Under existing law the USACE requires compensatory mitigation to replace aquatic resource functions unavoidably lost or adversely affected by authorized activities. The objective of this mitigation plan is to compensate for adverse conditions associated with the loss of 4,604 feet of stream. To compensate the client will do on-site mitigation and also pay an in-lieu-fee.

6.1 Mitigation Work Plan

Mitigation for the sediment structures will be conducted within the degraded streambeds, while mitigation for the the hollowfills will be conducted by constructing natural stream drainages on the sides. Linear feet restored for the

ponds will be equal to pre-disturbance levels. There will be one drainage at the top of each hollowfill and one drainage down each side. Figures 2-4 and Table 6 illustrate the drainage lengths that will be used for mitigation purposes. Only a single side drainage of the hollowfills will be used for mitigation requirements. The top drainage of each hollowfill will be sloped toward the side to be used for mitigation to ensure that as much water as possible gets to the drainage used for mitigation. The top drainage of the hollowfills will be constructed at a 5 to 7 percent grade (on solid ground) and thus will function as a natural stream. Stream restoration in this section will follow profile and cross section plans that were collected at a stream of similar slope (Appendix E).

Based upon losses and gains at the project site, the client will need to offset the net loss of 1,955 feet (Table 6). To accomplish this, the client has agreed to pay an in-lieu-fee. Based upon the loss of 1,955 feet of stream, the client will need to pay an in-lieu-fee of $291,600.00. This money will go to satisfy compensatory mitigation requirements and help meet the USACE's goal of no overall net loss of waters of the U.S. In-lieu-fee calculations are summarized in Table 7. The Stream Compensation Ratio Calculator forms that were used to calculate mitigation amounts are located in Appendix F. EII Calculation Spreadsheets for pre-disturbance, immediately after disturbance, and 30 years after disturbance are included in Appendices G, H, I. A summary of these data sheets is located in Table 8. Mitigation in these streams will follow restoration plans outlined in Section 5.0. Pictures of the streams are included with the EII Data Spreadsheets in Appendix G.

Restoration efforts will proceed as soon as mining operations have concluded. After restoration, certain habitat features will recover quickly while others will take time to mature. Both vegetative protection and riparian width will take time to come back, while the other eight parameters should come back more quickly (and in some instances even exceed pre-disturbance levels).

6.2 Site Protection

No site protection is proposed for the restored stream areas. To account for this, the risk factor used in the stream compensation ratio calculator, which is set at 20 percent for most projects, was set at 50.

Table 6. Stream compensation ratio calculator for proposed mitigation efforts at three streams in Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Impact Reach Name	Impacted Site			Mitigation Site								
				Mitigation Timing and Risk			EII			Mitigation (feet)		
	Length	Pre EII	Post EII	Start	Mature	Risk (%)	Pre-work	Immediately After	At Maturity	Length Required	Length Offered	Balance
Hollowfill #15 (ephemeral)	665	.20	0	2010	2040	50	0	.32	.37	386	386	0
Hollowfill #15 (intermittent)	1,064	.20	0	2010	2040	50	0	.32	.37	739	72	930
SS #106 (intermittent)	112	.20	0.1	2010	2040	50	0.1	.38	.43	39	39	0
Hollowfill #16 (ephemeral)	814	.38	0	2010	2040	50	0	.30	.35	953	953	0
Hollowfill #16 (intermittent)	1,025	.38	0	2010	2040	50	0	.30	.35	1,025	0	1,025
SS #107 (intermittent)	135	.39	0.1	2010	2040	50	0.1	.38	.43	136	135	0
Hollowfill #17 (ephemeral)	684	.25	0	2010	2040	50	0	.30	.34	535	535	0
SS #92 (intermittent)	105	.25	0.1	2010	2040	50	0.1	.30	.34	76	76	0
Total	**4,604**											**1,955**

- All mitigation will occur at the site of disturbance.

Table 7. In-lieu fee summary at three streams in Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Impact Reach Name	Stream Length Balance	EII	EIU	Compensatory Mitigation Ratio	In-Lieu Fee
Hollowfill #15 (ephemeral)	0	.20	0	-	0
Hollowfill #15 (intermittent)	930	.20	186	1.13	$125,550.00
SS #106 (intermittent)	0	.20	0	-	0
Hollowfill #16 (ephemeral)	0	.38	0	-	0
Hollowfill #16 (intermittent)	1,025	.38	389.5	1.35	$166,050.00
SS #107 (intermittent)	0	.39	0	-	0
Hollowfill #17 (ephemeral)	0	.25	0	-	0
SS #92 (intermittent)	0	.25	0	-	0
Total	**1,955**		**575.5**		**$291,600.00**

Table 8. Individual habitat assessment parameters for hollowfills No. 15, 16, and 17 and sediment structures No. 106, 107, and 92 for present day, immediately after restoration, and 30 years after restoration, Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Site	Time Period	Parameter										Total
		Epifaunal Substrate	Embeddedness	Velocity/Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles	Bank Stability	Vegetative Protection	Riparian Width	
HF 15	Pre-disturbance	4	6	5	6	2	5	19	6	6	4	63
	5 Years	17	17	10	17	2	15	20	18	12	14	142
	30 Years	17	17	10	17	2	15	20	18	14	18	148
SS 106	Pre-disturbance	1	1	1	1	10	1	1	8	4	6	34
	5 Years	17	17	10	17	10	15	20	18	12	14	150
	30 Years	17	17	10	17	10	15	20	18	14	18	156
HF 16	Pre-disturbance	10	10	9	10	1	9	19	8	10	4	90
	5 Years	17	17	9	17	1	15	20	18	12	14	140
	30 Years	17	17	9	17	1	15	20	18	14	18	146
SS 107	Pre-disturbance	13	10	10	10	9	9	19	8	10	4	102
	5 Years	17	17	10	17	9	15	20	18	12	14	149
	30 Years	17	17	10	17	9	15	20	18	14	18	155
HF 17	Pre-disturbance	11	9	9	9	0	12	19	6	10	12	97
	5 Years	17	17	9	17	0	15	20	18	12	14	139
	30 Years	17	17	9	17	0	15	20	18	16	18	145
SS 92	Pre-disturbance	10	9	9	9	0	1	16	8	4	6	72
	5 Years	17	17	9	17	0	15	20	18	12	14	139
	30 Years	17	17	9	17	0	15	20	18	16	18	145

7.0 MONITORING

7.1 Monitoring and Long-term Management

Following the implementation of the restoration plan, a professional engineer will certify to the USACE that construction meets or exceeds planned goals. Following successful restoration, the restored areas will be monitored for five years. This monitoring plan will evaluate the success of the mitigation work and will allow for any necessary adjustments to assure the success of the restoration site. Annual monitoring reports will be submitted to the appropriate USACE office no later than 31 December of the year following completion of the restoration efforts. The annual monitoring reports will include an inspectors report and photographs with locations shown on project maps. If during the time that the restored areas are monitored, there are significant failures in the design of the restored streams, a revised mitigation plan will be submitted to fix any shortcomings in the original mitigation plan. If at the end of the five years the restoration efforts are deemed a success, the applicant shall be released from all permit obligations.

Monitoring will consist of grading the restored area yearly using the High Gradient Stream Restoration Sheets (Barbour et al. 1999). The following parameters will be monitored; pH, specific conductance, dissolved oxygen, epifaunal substrate, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative protection, and riparian zone. Table 9 illustrates success standards and method of determination for each of these parameters.

Table 9. Factors to be considered when determining successful stream restoration, Knott County, Kentucky (Permit No. 860-0380, A. No. 6).

Parameter/Observation	Success Standards	Method of Determination
Field pH	*Report Only*	*Field Meter*
Specific Conductance	Report Only	Field Meter
Dissolved Oxygen	Report Only	Field Meter
Epifaunal Substrate	Minimum 70% favorable substrate	Pebble count; Estimate of available
Embeddedness	Maximum 20% embeddedness	Pebble count; measure embeddedness
Velocity/Depth Regime	Maintain step-pool or riffle-pool sequences similar to approved plans	Longitudinal profile
Sediment Deposition	Little or no enlargement of Islands or point bars and <5% of the bottom affected by sediment deposition	Pebble counts in pools
Channel Flow Status	Maintain width/depth ratio similar to accordance with plans	Determine from X-sections
Channel Alternation	Maintain minimal channelization similar to approved plans	Longitudinal profiles; X-sections
Frequency of Riffles	Maintain step-pool or riffle-pool sequences similar to approved plans	Longitudinal profile
Bank Stability	Banks stable	Bank Erosion Index; Observe density & depth of plant roots, near bank shear stress
Vegetative Protection	Approved width of riparian zone planted with minimum 300 stems/acre surviving	Measure replanted width; estimated stem count
Riparian Zone	Riparian zone with a variety of species alive and healthy	Measure replanted width; estimated stem count

7.2 Financial Assurances

Nally & Hamilton Enterprises, Inc. will assume all responsibility for success at the proposed mitigation site. Based upon this assumption of responsibility, no set aside fund is considered necessary.

8.0 RESPONSIBLE PARTIES

8.1 Applicant

Nally & Hamilton Enterprises, Inc.
P.O. Box 157
Bardstown, KY 40004
(606) 878-1500

8.2 Preparer of Restoration Plan

Apogee Environmental Consultants, Inc. (Joel Beverly)
P.O. Box 338
Ermine, KY 41815
(606) 633-7677

9.0 LITERATURE CITED

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in wadeable streams and rivers: periphyton, benthic macroinvertebrates, and fish (2nd edition). The United States Environmental Protection Agency, Washington, D.C. EPA 841-B-99-002.

Beverly, J. 2003. An aquatic biological assessment for a proposed surface mine near Littcarr, Knott County, Kentucky (Application # 860-0404). Final report submitted to Gress Engineering, Appalachia, VA. 13 pp plus appendices.

Kentucky Division of Water. 2002. A macroinvertebrate bioassessment index for headwater streams of the Eastern Coalfield Region, Kentucky. Frankfort, KY. 48 pp.

Rosgen, D. L. 1994. A classification of natural rivers. Catena, 169-199. Elsevier Science B. V. Amsterdam.

Woods, A.J., Omernik, J.M., Martin, W.H., Pond, G.J., Andrews, W.M., Call, S.M., Comstock, J.A., and Taylor, D.D.. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs). Reston, VA., U.S. Geological Survey (map scale 1:1,000,000).

Appendix A

Completed High Gradient Stream Data Sheets

High Gradient Stream Data Sheet

STREAM NAME: Sugar Branch	LOCATION: HF-16
STATION #: MILE:	BASIN/WATERSHED: N. Fork KY River
LAT.: LONG.:	COUNTY: Knott USGS 7.5 TOPO: Blackey
DATE: 14 Dec 05 TIME: 4:30 ☐AM ☒PM	INVESTIGATORS: Joel Beverly

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:	Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
	θ	θ Heavy rain	θ Yes ☒No
	θ	θ Steady rain	Air Temperature ____ °C. Inches rainfall in past 24 hours ____ in.
	☒	☒ Intermittent showers	____ % Cloud Cover
	θ	θ Clear/sunny	

P-Chem: Temp(°C) 3.6 D.O. (mg/l)_____ %Saturation_____ pH(S.U.) 7.8 Cond. 270 θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width	_____	ft
Range of Depth	_____	ft
Average Velocity	_____	ft/s
Discharge	_____	cfs
Est. Reach Length	_____	

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use: logging, roads

θ Surface Mining	θ Construction	☒Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
☒Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other _____

Stream Flow:
θ Dry θ Pooled ☒Low θ Normal
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
☒Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
☒Trees ☒Shrubs
θ Grasses ☒Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
☒Partially Shaded (50-75%)
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
☒Channelization
(θFull θPartial)

Substrate θEst. θP.C.	Riffle_____%	Run_____%	Pool_____%
Silt/Clay (<0.06 mm)	See		
Sand (0.06 – 2 mm)			
Gravel (2-64 mm)	Pebble		
Cobble (64 – 256 mm)			
Boulders (>256 mm)	Count		
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s. deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0

HF-16

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment: 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0

Total Score 90

NOTES/COMMENTS:

High Gradient Stream Data Sheet

STREAM NAME: Sugar Branch | LOCATION: Pond 107

STATION #: | MILE: | BASIN/WATERSHED: N. Fork KY River

LAT.: | LONG.: | COUNTY: Knott | USGS 7.5 TOPO: Blackey

DATE: 14 Dec 05 TIME: 3:45 ☐AM ☒PM | INVESTIGATORS: Joel Beverly

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
X	X Intermittent showers
θ	θ Clear/sunny

Has there been a heavy rain in the last 7 days? θ Yes X No

Air Temperature ____ °C. Inches rainfall in past 24 hours ____ in.

____ % Cloud Cover

P-Chem: Temp(°C) 3.6 D.O. (mg/l) ____ %Saturation ____ pH(S.U.) 7.8 Cond. 270 θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width	____ ft
Range of Depth	____ ft
Average Velocity	____ ft/s
Discharge	____ cfs
Est. Reach Length	____

LOCAL WATERSHED FEATUREES: Predominant Surrounding Land Use: logging, roads

θ Surface Mining	θ Construction	X Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
X Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ____

Stream Flow:
θ Dry θ Pooled X Low θ Normal
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
X Trees X Shrubs
θ Grasses X Herbaceous
Number of strata ____

Canopy Cover.
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
X Partially Shaded (50-75%)
θ Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
X Channelization
(θFull θPartial)

Substrate θEst. θP.C.	Riffle ____%	Run ____%	Pool ____%
Silt/Clay (<0.06 mm)	See		
Sand (0.06 – 2 mm)			
Gravel (2-64 mm)	Pebble		
Cobble (64 – 256 mm)			
Boulders (>256 mm)		Count	
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0

Pond 107

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0

Total Score

(17)

NOTES/COMMENTS:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed trib to Defeated LOCATION: HF - 15

STATION #: MILE: BASIN/WATERSHED: North Fork KY River

LAT.: LONG.: COUNTY: Knott USGS 7.5 TOPO: Blackey

DATE: 2 Dec 05 TIME: 3:45 ☐AM ☒PM INVESTIGATORS: Joel Beverly

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:	Now	Past 24 hours	Has there been a heavy rain in the last 7 days?
	θ	θ Heavy rain	X Yes θ No
	θ	θ Steady rain	Air Temperature 39 °C. Inches rainfall in past 24 hours ____ in
	θ	X Intermittent showers	0 % Cloud Cover
	X	θ Clear/sunny	

P-Chem: Temp(°C) 2.2 D.O. (mg/l) _____ %Saturation _____ pH(S.U.) 7.8 Cond. 410 θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width	_____	ft
Range of Depth	_____	ft
Average Velocity	_____	ft/s
Discharge	_____	cfs
Est. Reach Length	_____	

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use: logging

X Surface Mining	θ Construction	X Forest
0 Deep Mining	0 Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
0 Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other hollow fill (old)

Stream Flow:
X Dry θ Pooled θ Low θ Normal
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial θ Intermittent
X Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type
X Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
X Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
θ Fully Shaded (75-100%)

Channel Alterations:
X Dredging
X Channelization
(θFull θPartial)

Substrate θEst. θP.C.	Riffle ____%	Run ____%	Pool ____%
Silt/Clay (<0.06 mm)	See		
Sand (0.06 – 2 mm)			
Gravel (2-64 mm)	Pebble		
Cobble (64 – 256 mm)			
Boulders (>256 mm)		Count	
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0

HF - 15

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 (2) 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0

Total Score

44

NOTES/COMMENTS:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed trib to Defeated Cr.	LOCATION: Pond 106 (existing pond)
STATION #: MILE:	BASIN/WATERSHED: North Fork KY River
LAT.: LONG.:	COUNTY: Knott USGS 7.5 TOPO: Blackey
DATE 2 Dec 06 TIME: 3:00 ☐AM ☒PM	INVESTIGATORS: Joel Beverly

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	X Intermittent showers
X	θ Clear/sunny

Has there been a heavy rain in the last 7 days? X Yes 0 No

Air Temperature 39 °F. Inches rainfall in past 24 hours ____ in.

0 % Cloud Cover

P-Chem: Temp(°C) 22 D.O. (mg/l)____ %Saturation____ pH(S.U.) 7.8 Cond. 410 θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width	____ ft
Range of Depth	____ ft
Average Velocity	____ ft/s
Discharge	____ cfs
Est. Reach Length	____

LOCAL WATERSHED FEATURES:

Predominant Surrounding Land Use: logging

X Surface Mining	θ Construction	X Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
θ Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other

Stream Flow:
θ Dry θ Pooled X Low θ Normal
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial X Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
X Trees θ Shrubs
θ Grasses θ Herbaceous
Number of strata ___

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
X Partially Shaded (50-75%)
θ Fully Shaded (75-100%)

Channel Alterations:
X Dredging
θ Channelization
(θFull θPartial)

Substrate θEst. θP.C.	Riffle____%	Run____%	Pool____%
Silt/Clay (<0.06 mm)	See		
Sand (0.06 – 2 mm)			
Gravel (2-64 mm)	Pebble		
Cobble (64 – 256 mm)			
Boulders (>256 mm)	Count		
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0

Pond 106

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0

Total Score

34

NOTES/COMMENTS:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed trib to Carr Cr. 4.1e LOCATION: HF-17

STATION #: MILE: BASIN/WATERSHED: N. Fork KY

LAT. 37°12'57" LONG.: 82°58'12" COUNTY: Knott USGS 7.5 TOPO: Blackey

DATE: 8 Jan 05 TIME: 3:45 ☐AM ☒PM INVESTIGATORS: Joel Beverly

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER:

Now	Past 24 hours
θ	θ Heavy rain
θ	θ Steady rain
θ	θ Intermittent showers
X	X Clear/sunny

Has there been a heavy rain in the last 7 days? X Yes θ No

Air Temperature ____ °C. Inches rainfall in past 24 hours 0 in.

____ % Cloud Cover

P-Chem: Temp(°C) 5.6 D.O. (mg/l) ____ %Saturation 0 pH(S.U.) 7.3 Cond. 368 θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width ____ ft
Range of Depth ____ ft
Average Velocity ____ ft/s
Discharge ____ cfs
Est. Reach Length ____

LOCAL WATERSHED FEATUREES:

Predominant Surrounding Land Use: gas wells

X Surface Mining	θ Construction	X Forest
θ Deep Mining	θ Commercial	θ Pasture/Grazing
0 Oil Wells	θ Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
θ Dams θ Bridge Abutments
θ Island θ Waterfalls
θ Other ____

Stream Flow:
X Dry 0 Pooled θ Low θ Normal
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial 0 Intermittent
X Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
X Trees X Shrubs
θ Grasses X Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
X Fully Shaded (75-100%)

Channel Alterations:
θ Dredging
X Channelization
(θFull θPartial)

Substrate θEst. θP.C.	Riffle ____%	Run ____%	Pool ____%
Silt/Clay (<0.06 mm)	See		
Sand (0.06 – 2 mm)			
Gravel (2-64 mm)	Pebble		
Cobble (64 – 256 mm)			
Boulders (>256 mm)	Count		
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0

HT-17

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 (0)
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0

Total Score

97

NOTES/COMMENTS:

High Gradient Stream Data Sheet

STREAM NAME: Unnamed trib to Carr Creek LOCATION: SS # 96 - A6

STATION #: MILE: BASIN/WATERSHED: N. Fork KY

LAT.: 37°12'59" LONG.: 82°58'12" COUNTY: Knott USGS 7.5 TOPO: Blackey

8 Jan 06 DATE: [illegible] TIME: 2:00 ☐AM ☒PM INVESTIGATORS: Joel Beverly

TYPE SAMPLE: θ P-CHEM θ Macroinvertebrate θ FISH θ BACT.

WEATHER: Now / Past 24 hours
- θ / 0 Heavy rain
- 0 / θ Steady rain
- θ / θ Intermittent showers
- X / X Clear/sunny

Has there been a heavy rain in the last 7 days? X Yes θ No

Air Temperature ____ °C. Inches rainfall in past 24 hours 0 in.

5 % Cloud Cover

P-Chem. Temp(°C) 5.6°C D.O. (mg/l)_____ %Saturation_____ pH(S.U.) 7.3 Cond. 368 θ Grab

INSTREAM WATERSHED FEATURES:

Stream Width	ft
Range of Depth	ft
Average Velocity	ft/s
Discharge	cfs
Est. Reach Length	

LOCAL WATERSHED FEATURES:

Predominant Surrounding Land Use: Gas Wells

X Surface Mining	θ Construction	X Forest
θ Deep Mining	0 Commercial	θ Pasture/Grazing
0 Oil Wells	0 Industrial	θ Silviculture
θ Land Disposal	θ Row Crops	θ Urban Runoff/Storm Sewers

Hydraulic Structures:
X Dams θ Bridge Abutments
0 Island θ Waterfalls
θ Other

Stream Flow:
θ Dry θ Pooled θ Low X Normal
θ High θ Very Rapid or Torrential

Stream Type:
θ Perennial X Intermittent
θ Ephemeral θ Seep

Riparian Vegetation: Dom. Tree/Shrub Taxa
Dominate Type:
X Trees X Shrubs
θ Grasses X Herbaceous
Number of strata ____

Canopy Cover:
θ Fully Exposed (0-25%)
θ Partially Exposed (25-50%)
θ Partially Shaded (50-75%)
X Fully Shaded (75-100%)

Channel Alterations:
X Dredging
θ Channelization (θFull θPartial) Old Sediment control structure that has filled in

Substrate θEst. θP.C.	Riffle____%	Run____%	Pool____%
Silt/Clay (<0.06 mm)	See Pebble Count		
Sand (0.06 – 2 mm)			
Gravel (2-64 mm)			
Cobble (64 – 256 mm)			
Boulders (>256 mm)			
Bedrock			

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Sow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0

SS # 96 92

4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 (0)
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8.Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 (3)	2 1 0

Total Score

72

NOTES/COMMENTS:

Appendix B

Stratum Rank Key

Stratum Rank Key

Class	Description
SR-9	A sole dominant species; no other species exceed SR-2.
SR-8	A species so outstanding as to be called the sole dominant; no other species exceeds SR-6. (Given to only one species)
SR-7	A species sharing dominance. Given to one, but rarely two species (for example, oak – hickory).
SR-6	A species sharing dominance with another, but markedly less important than the main dominant, or a species sharing dominance more or less equally with a number of species.
SR-5	Given to the third or forth subdominant where there are two clear dominants, usually given only if all remaining species have low SRs.
SR-4	A subordinate species, not a dominant or subdominant, but contributing significantly to both numbers and cover.
SR-3	A species with three to several individuals furnishing substantial cover.
SR-2	A species with two to several individuals, but infrequent in number and inconsequential in cover.
SR-1	A species for which only a single individual is observed.

Appendix C

Completed Data Sheets for Longitudinal Profiles, Pebble Counts, and Cross Sections

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Longitudinal Profile Data Sheet – Hollow Fill 2

Project # 05.02 Project Name Carr Creek 404

Stream/Drainage Unnamed Trib. To Carr Creek Date 10/8/03

GPS: N 37°14'02.4" W 82°58'25.0"

County Knott State KY Quad Blackey

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
1	0.0	1209.6	Riffle	Dry	0.3
2	10.8	1210.2	Pool	Dry	
3	13.1	1209.7	Riffle	Dry	
4	17.3	1211.0	Pool	Dry	
5	36.2	1213.1	Riffle	Dry	
6	40.3	1212.4	Riffle	Dry	
7	43.9	1214.1	Pool	Dry	
8	57.2	1216.6	Riffle	Dry	
9	59.5	1216.1	Riffle	Dry	
10	65.7	1217.9	Pool	Dry	
11	68.5	1217.6	Riffle	Dry	
12	69.8	1217.9	Pool	Dry	
13	76.4	1218.6	Riffle	Dry	
14	99.7	1221.2	Riffle	Dry	0.8
15	112.0	1223.7	Riffle	Dry	
16	120.8	1224.5	Riffle	Dry	
17	138.1	1226.6	Riffle	Dry	
18	149.7	1228.4	Riffle	Dry	
19	153.1	1227.6	Riffle	Dry	
20	157.9	1228.2	Pool	Dry	
21	161.5	1231.6	Pool	Dry	0.8
22	189.5	1234.4	Riffle	Dry	
23	192.4	1234.1	Riffle	Dry	
24	195.0	1234.9	Pool	Dry	
25	216.3	1236.7	Riffle	Dry	
26	218.8	1236.0	Pool	Dry	
27	222.7	1237.2	Riffle	Dry	
28	225.5	1237.1	Riffle	Dry	
29	229.3	1239.0	Pool	Dry	
30	234.3	1239.9	Riffle	Dry	

APOGEE
ENVIRONMENTAL CONSULTANTS LLC

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
31	235.4	1239.6	Pool		
32	241.2	1240.5	Riffle	Dry	
33	261	1242.7	Riffle	Dry	
34	265.2	1242.4	Riffle	Dry	
35	268.9	1243.6	Pool	Dry	
36	298.1	1245.6	Riffle	Dry	
37	307.2	1246.5	Riffle	Dry	
38	311.5	1246.0	Pool	Dry	0.9
39	316.1	1247.6	Pool	Dry	
40	336.2	1279.5	Riffle	Dry	
41	352.5	1252.1	Riffle	Dry	
42	354.1	1251.6	Riffle	Dry	
43	356.5	1252.5	Pool	Dry	
44	371.1	1255.2	Riffle	Dry	
45	373.1	1254.6	Riffle	Dry	
46	375.5	1256.1	Pool	Dry	
47	400	1260.4	Riffle	Dry	
48	402.9	1259.8	Riffle	Dry	
49	407.2	1262.9	Pool	Dry	
50	435.9	1266.0	Riffle	Dry	
51	441.9	1268.7	Pool Confluent	Dry	1.3
52	457.7	1270.7	Riffle	Dry	
53	460	1270.4	Riffle	Dry	
54	462.9	1271.8	Pool	Dry	
55	480.4	1275.1	Riffle	Dry	
56	489.5	1277.4	Riffle	Dry	
57	491.4	1276.8	Riffle	Dry	
58	495.3	1278.6	Pool	Dry	
59	508.6	1280.1	Riffle	Dry	
60	516.6	1281.5	Riffle	Dry	

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
61	530.4	1286.5	Pool	Dry	
62	532.7	1285.8	Riffle	Dry	
63	535.4	1287.3	Pool	Dry	
64	545.1	1292.0	Riffle	Dry	
65	560.7	1295.5	Riffle	Dry	
66	568.7	1297.7	Riffle	Dry	
67	584.9	1300	Riffle	Dry	
68	586.2	1299.7	Riffle	Dry	
69	591.7	1302.2	Pool	Dry	
70	606.5	1306.7	Riffle	Dry	
71	610.3	1306.5	Pool Confluent	Dry	1.1
72	612.1	1307.3	Riffle	Dry	
73	622.7	1312.1	Riffle	Dry	
74	629.4	1316.7	Riffle	Dry	
75	634	1318	Riffle	Dry	0.8
76	648.6	1320.1	Riffle	Dry	
77	655.8	1319.6	Pool	Dry	
78	657.9	1320.8	Riffle	Dry	
79	671.2	1322.7	Riffle	Dry	
80	672.7	1324	Riffle	Dry	
81	675.2	1324.3	Riffle	Dry	
82	678.9	1326.7	Riffle	Dry	
83	688.2	1327.9	Riffle	Dry	
84	695.7	1331.6	Riffle	Dry	
85	703.1	1332.8	Riffle	Dry	
86	707.1	1335.7	Riffle	Dry	
87	717.5	1338.5	Riffle	Dry	
88	724	1341.5	Riffle	Dry	0.6
89	726.4	1343.4	Riffle	Dry	
90	730.7	1344.6	Riffle	Dry	

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
91	735.1	1348.1	Riffle	Dry	
92	744.6	1350.8	Riffle	Dry	
93	748.8	1354.1	Riffle	Dry	
94	752.4	1356.5	Riffle	Dry	
95	762	1358.6	Riffle	Dry	
96	763.3	1359.7	Riffle	Dry	0.6
97	766.8	1360.9	Riffle	Dry	
98	769	1360.6	Pool	Dry	
99	773.1	1362.6	Riffle	Dry	
100					
101	Tributary				
102	0.0	1266	Pool	Dry	
103	3.2	1268.1	Riffle	Dry	0.6
104	14.9	1269.4	Riffle	Dry	
105	17.5	1268.4	Pool	Dry	
106	21.1	1270.8	Riffle	Dry	
107	34.7	1273.8	Riffle	Dry	
108	36.3	1273.4	Pool	Dry	
109	41.3	1275.9	Riffle	Dry	
110	52.3	1277.8	Riffle	Dry	
111	72.9	1283.4	Riffle	Dry	
112	76.4	1285.1	Riffle	Dry	
113	87.8	1286.7	Riffle	Dry	
114	98.5	1290.4	Riffle	Dry	
115					
116	Tributary				
117	0.0	1306.7	Pool	Dry	
118	3.1	1306.9	Riffle	Dry	
119	7.9	1311.5	Riffle	Dry	
120	12.4	1311.9	Riffle	Dry	

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
121	13.6	1311.4	Pool	Dry	
122	17.2	1313.9	Riffle	Dry	
123	21	1314.5	Riffle	Dry	
124	22.9	1314.2	Pool	Dry	1.2
125	25.6	1315.9	Riffle	Dry	
126	27.2	1315.6	Pool	Dry	
127	30.8	1316.8	Riffle	Dry	
128	35	1317.1	Riffle	Dry	
129	39.3	1317.7	Riffle	Dry	
130	48.8	1319.1	Riffle	Dry	
131	51.4	1320	Riffle	Dry	
132	53.8	1319.5	Pool	Dry	
133	56.1	1320.9	Riffle	Dry	
134	57.2	1320.7	Riffle	Dry	
135	59.5	1321.8	Riffle	Dry	
136	69.8	1324.6	Riffle	Dry	
127	74.9	1327.7	Riffle	Dry	
138	77.1	1327.8	Riffle	Dry	
139	79.1	1328.9	Riffle	Dry	
140	87.9	1332.2	Riffle	Dry	
141	97.8	1334.1	Riffle	Dry	
142	100.6	1334.7	Riffle	Dry	
143	103.2	1335	Pool	Dry	0.7
144	106.3	1337.3	Riffle	Dry	
145	109	1336.9	Pool	Dry	
146	113.4	1339.9	Riffle	Dry	
147	117.3	1340.9	Riffle	Dry	
148	119.6	1342.3	Riffle	Dry	
149	126.5	1342.9	Riffle	Dry	
150	128.1	1344.3	Riffle	Dry	0.6

(Family Level Taxonomy - Riffle Only Sample)

Project ID:	Nally & Hamilton (Permit No. 860-0380, Am #6)
Stream/Reach:	HF-15
	Unnamed Tributary to Defeated Creek
Assessment Objectives:	

EII		Model	
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.20	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	4	no units (0-20)
2. Embeddedness	6	no units (0-20)
3. Velocity/Depth Regime	5	no units (0-20)
4. Sediment Deposition	6	no units (0-20)
5. Channel Flow Status	2	no units (0-20)
6. Channel Alteration	5	no units (0-20)
7. Freq. Of Riffles (bends)	19	no units (0-20)
8. Bank stability (both combined)	6	no units (0-20)
9. Veg. Protection (both combined)	6	no units (0-20)
10. Riparian Width (both combined)	4	no units (0-20)
Total Habitat Score	63	no units
Habitat Integrity Index		Subindex 0.10
Macroinvertebrate Data - Family Level		

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

(Riffle Only)

11. Family Taxa Richness	0	# of taxa sampled
12. Family EPT Richness	0	# of EPT species sampled
13. % Ephemeroptera	0	% Mayflies (0-100)
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)
16. mFBI	0	no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	410	microMhos	0.5

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

(Family Level Taxonomy - Riffle Only Sample)

Project ID:	Nally & Hamilton (Permit No. 860-0380, Am #6)
Stream/Reach:	Pond 106
	Unnamed Tributary to Defeated Creek
Assessment Objectives:	

EII		Model	
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.20	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	1	no units (0-20)
2. Embeddedness	1	no units (0-20)
3. Velocity/Depth Regime	1	no units (0-20)
4. Sediment Deposition	1	no units (0-20)
5. Channel Flow Status	10	no units (0-20)
6. Channel Alteration	1	no units (0-20)
7. Freq. Of Riffles (bends)	1	no units (0-20)
8. Bank stability (both combined)	8	no units (0-20)
9. Veg. Protection (both combined)	4	no units (0-20)
10. Riparian Width (both combined)	6	no units (0-20)
Total Habitat Score	34	no units

Subindex
0.10

Macroinvertebrate Data - Family Level

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

(Riffle Only)

11. Family Taxa Richness	0	# of taxa sampled
12. Family EPT Richness	0	# of EPT species sampled
13. % Ephemeroptera	0	% Mayflies (0-100)
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)
16. mFBI	0	no units
Macroinvertebrate Bioassessment	NA	no units NA
Conductivity	410	microMHOS 0.01

APOGEE ENVIRONMENTAL CONSULTANTS LLC

(Family Level Taxonomy - Riffle Only Sample)

Project ID:	Nally & Hamilton (Permit No. 860-0380, Am #6)
Stream/Reach:	HF 16
	Sugar Branch
Assessment Objectives:	

EII		Model	
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.38	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	10	no units (0-20)
2. Embeddedness	10	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	10	no units (0-20)
5. Channel Flow Status	1	no units (0-20)
6. Channel Alteration	9	no units (0-20)
7. Freq. Of Riffles (bends)	19	no units (0-20)
8. Bank stability (both combined)	8	no units (0-20)
9. Veg. Protection (both combined)	10	no units (0-20)
10. Riparian Width (both combined)	4	no units (0-20)
Total Habitat Score	90	no units

Subindex
0.10

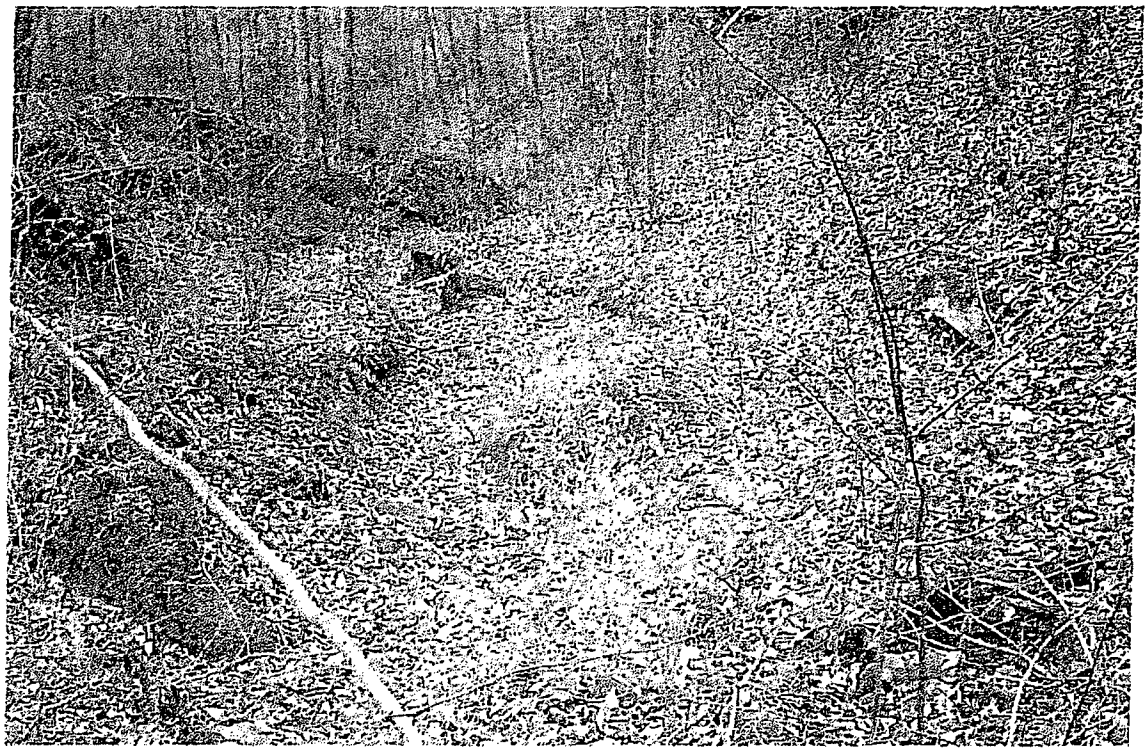
Habitat Integrity Index

Macroinvertebrate Data - Family Level

APOGEE ENVIRONMENTAL CONSULTANTS LLC

(Riffle Only)

11. Family Taxa Richness	0	# of taxa sampled	
12. Family EPT Richness	0	# of EPT species sampled	
13. % Ephemeroptera	0	% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)	
16. mFBI	0	no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	270	microMhos	0.56



APOGEE ENVIRONMENTAL CONSULTANTS LLC

(Family Level Taxonomy - Riffle Only Sample)

Project ID:	Nally & Hamilton (Permit No. 860-0380, Am #6)
Stream/Reach:	Pond-107
	Sugar Branch
Assessment Objectives:	

EII		Model	
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.39	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	13	no units (0-20)
2. Embeddedness	10	no units (0-20)
3. Velocity/Depth Regime	10	no units (0-20)
4. Sediment Deposition	10	no units (0-20)
5. Channel Flow Status	9	no units (0-20)
6. Channel Alteration	9	no units (0-20)
7. Freq. Of Riffles (bends)	19	no units (0-20)
8. Bank stability (both combined)	8	no units (0-20)
9. Veg. Protection (both combined)	10	no units (0-20)
10. Riparian Width (both combined)	4	no units (0-20)
Total Habitat Score	102	no units

Subindex
Habitat Integrity Index 0.12

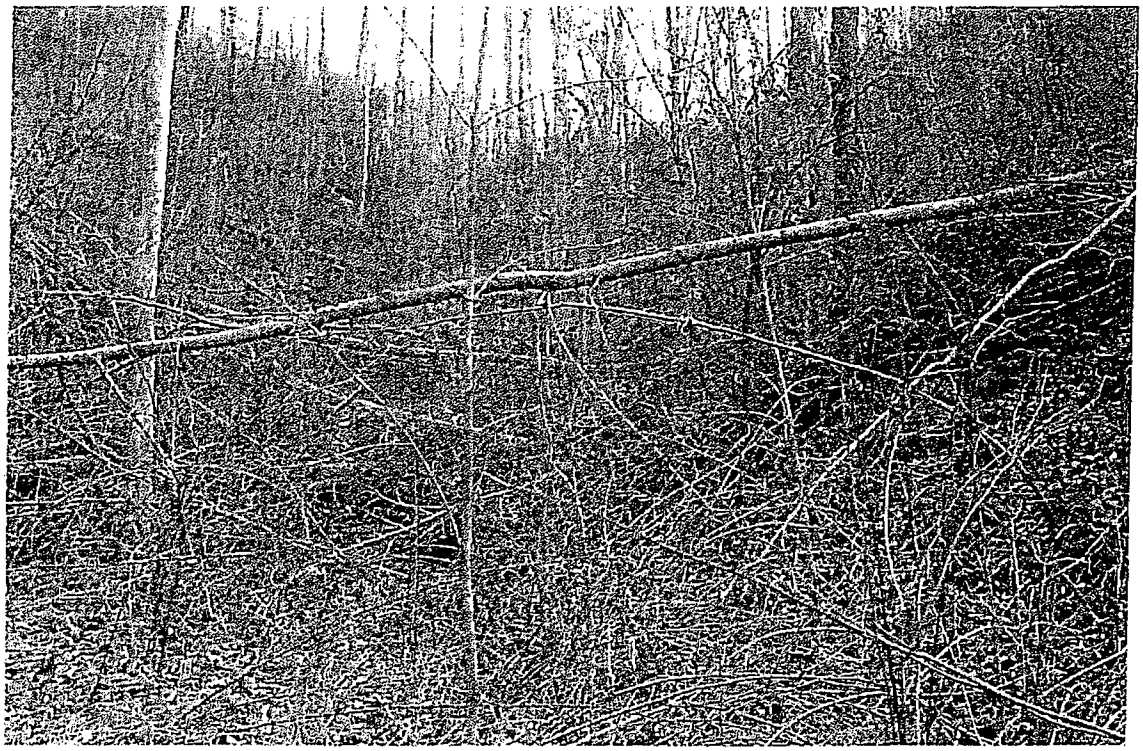
Macroinvertebrate Data - Family Level

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

(Riffle Only)

11. Family Taxa Richness	0	# of taxa sampled
12. Family EPT Richness	0	# of EPT species sampled
13. % Ephemeroptera	0	% Mayflies (0-100)
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)
16. mFBI	0	no units

Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	270	microMHOs	0.56



APOGEE ENVIRONMENTAL CONSULTANTS LLC

(Family Level Taxonomy - Riffle Only Sample)

Project ID:	Nally & Hamilton (Permit No. 860-0380, Am #6)
Stream/Reach:	HF-17
	Unnamed Tributary to Carr Creek Lake
Assessment Objectives:	

EII		Model	
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.25	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	11	no units (0-20)
2. Embeddedness	9	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	9	no units (0-20)
5. Channel Flow Status	0	no units (0-20)
6. Channel Alteration	12	no units (0-20)
7. Freq. Of Riffles (bends)	19	no units (0-20)
8. Bank stability (both combined)	6	no units (0-20)
9. Veg. Protection (both combined)	10	no units (0-20)
10. Riparian Width (both combined)	12	no units (0-20)
Total Habitat Score	97	no units

Subindex
Habitat Integrity Index 0.[illegible]

Macroinvertebrate Data - Family Level

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

(Family Level Taxonomy - Riffle Only Sample)

Project ID:	Nally & Hamilton (Permit No. 860-0380, Am #6)
Stream/Reach:	Pond 92
	Unnamed Tributary to Carr Creek Lake
Assessment Objectives:	

EII		Model	
NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.25	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units
RBP Habitat Parameters		
1. Epifaunal Substrate	10	no units (0-20)
2. Embeddedness	9	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	9	no units (0-20)
5. Channel Flow Status	0	no units (0-20)
6. Channel Alteration	1	no units (0-20)
7. Freq. Of Riffles (bends)	16	no units (0-20)
8. Bank stability (both combined)	8	no units (0-20)
9. Veg. Protection (both combined)	4	no units (0-20)
10. Riparian Width (both combined)	6	no units (0-20)
Total Habitat Score	72	no units

Subindex	
Habitat Integrity Index	0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Stream Compensation Ratio Calculator version 3.4

Inputs	Time Horizon: 76	Impacted Site				Mitigation Site							
Project ID #:	DNR # 660-0360, A.6	Impact Year: 2007				Mitigation Work Timing & Risk				Ecological Integrity Index			
Project Name:	Sugar Branch	Ecological Integrity Index		Length	Balance								
Impact Reach (IR):		Pre-Impact	Post-Impact	(ft)	(ft)	Mitigation Reach (MR) Name	Year Started	Year Matured	Failure Risk	Pre-Work	Immediately After Work	At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
HF 15 (ephemeral)		0.20	0.00	665		HF 15 (ephemeral)	2007	2010	50	0.00	0.32	0.37	386	386
Reach Continued		0.20	0.00		0								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	

Outputs

Impact Reach vs Mitigation Reach	Ecological Integrity Compensation Ratios			Ratio (mitigation site feet per impact site foot)
IR vs MR1			>>	0.58
IR vs MR2			(see note 15)	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EII) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EII) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), Immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Stream Compensation Ratio Calculator Version 3.4

Inputs

Time Horizon: 75

Project ID #: DNR # 880-0380, A.6

Project Name: Sugar Branch

Impacted Site

Impact Year: 2007

Impact Reach (IR):	Ecological Integrity Index: Pre-Impact	Ecological Integrity Index: Post-Impact	Length (ft)	Balance (ft)
HE 16 (Intermittent)	0.20	0.00	1064	
Reach Continued	0.20	0.00		960
Reach Continued	0.20	0.00		930
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!

Mitigation Site

Mitigation Reach (MR) Name	Mitigation Work Timing & Risk: Year Started	Year Matured	Failure Risk	Ecological Integrity Index: Pre-Work	Ecological Integrity Index: Immediately After Work	Ecological Integrity Index: At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
SS 106	2010	2040	60 %	0.10	0.38	0.43	739	72
SS 92	2010	2040	60	0.10	0.30	0.34	927	29
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	

Outputs

Ecological Integrity Compensation Ratios

Impact Reach vs Mitigation Reach			(mitigation site feet per impact site foot)	Ratio
IR vs MR1			>=	0.69
IR vs MR2			>=	0.97
IR vs MR3			(see note 15)	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EII) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EII) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Stream Compensation Ratio Calculator Version 3.4

Inputs

Time Horizon: 76

Project ID #: DNR # 860-0380, A 8

Project Name: Sugar Branch

Impacted Site

Impact Year: 2007

Impact Reach (IR):	Ecological Integrity Index Pre-Impact	Ecological Integrity Index Post-Impact	Length (ft)	Balance (ft)
SS 106	0.20	0.10	112	0
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!
#VALUE!	#######	#######		#VALUE!

Mitigation Site

Mitigation Reach (MR) Name	Mitigation Work Timing & Risk: Year Started	Year Matured	Failure Risk	Ecological Integrity Index: Pre-Work	Immediately After Work	At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
SS 106	2010	>2040	50%	0.10	0.38	0.43	39	39
							#VALUE!	
							#VALUE!	
							#VALUE!	
							#VALUE!	
							#VALUE!	
							#VALUE!	
							#VALUE!	
							#VALUE!	
							#VALUE!	

Outputs

Ecological Integrity Compensation Ratios

Impact Reach vs Mitigation Reach			Ratio (mitigation site feet per impact site foot)	
IR vs MR1			>=	0.35
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#######	#VALUE!	#VALUE!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EII) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EII) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Stream Compensation Ratio Calculator Version 3.4

Inputs	Time Horizon: 76	Impacted Site				Mitigation Site								
Project ID #:	DNR # 860-0380, A.6	Impact Year: 2007												
Project Name:	Sugar Branch	Ecological Integrity Index				Mitigation Work Timing & Risk				Ecological Integrity Index				
Impact Reach (IR):		Pre-Impact	Post-Impact	Length (ft)	Balance (ft)	Mitigation Reach (MR) Name	Year Started	Year Matured	Failure Risk	Pre-Work	Immediately After Work	At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
HF 16 (ephemeral)		0.38	0.00	814		HF 16 (ephemeral)	2007	2010	50	0.00	0.30	0.35	953	953
Reach Continued		0.38	0.00		0								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!		#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	

Outputs	Ecological Integrity Compensation Ratios			Ratio (mitigation site feet per impact site foot)
Impact Reach vs Mitigation Reach				
IR vs MR1			>=	1.17
IR vs MR2			(see note 15)	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EII) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EII) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), Immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Stream Compensation Ratio Calculator version 3.4

Inputs

Time Horizon: 76

Project ID #: DNR # 860-0380, A.6

Project Name: Sugar Branch

Impact Reach (IR):	Impacted Site (Impact Year: 2007) Ecological Integrity Index Pre-Impact	Post-Impact	Length (ft)	Balance (ft)	Mitigation Site: Mitigation Work Timing & Risk Mitigation Reach (MR) Name	Year Started	Year Matured	Failure Risk	Ecological Integrity Index Pre-Work	Immediately After Work	At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
HF-16 (Intermittent)	0.38	0.00	1026									#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	

Outputs

Ecological Integrity Compensation Ratios

Impact Reach vs Mitigation Reach			(mitigation site feet per impact site foot)	Ratio
IR vs MR1			(see note 15)	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EII) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EII) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), Immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Stream Compensation Ratio Calculator Version 3.4

Inputs

Time Horizon: 75

Project ID # : DNR # 860-0380, A.6

Project Name: Sugar Branch

Impacted Site

Impact Year: 2007

Impact Reach (IR):	Ecological Integrity Index Pre-Impact	Ecological Integrity Index Post-Impact	Length (ft)	Balance (ft)
SS 107	0.39	0.10	135	
Reach Continued	0.39	0.10		1
Reach Continued	0.39	0.10		0
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!

Mitigation Site

Mitigation Reach (MR) Name	Mitigation Work Timing & Risk: Year Started	Year Matured	Failure Risk	Ecological Integrity Index: Pre-Work	Immediately After Work	At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
SS 107	2010	2040	50 %	0.10	0.38	0.43	136	135
SS 106	2010	2040	50	0.10	0.38	0.43	1	1
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	

Outputs

Ecological Integrity Compensation Ratios

Impact Reach vs Mitigation Reach				Ratio (mitigation site feet per impact site foot)
IR vs MR1			>=	1.01
IR vs MR2			>=	1.01
IR vs MR3			(see note 1)	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EI) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EI) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), Immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Stream Compensation Ratio Calculator Version 3.4

Inputs

Time Horizon: 76

Project ID #: DNR # 860-0380, A.6

Project Name: Sugar Branch

Impacted Site — Impact Year: 2007

Mitigation Site

Impact Reach (IR):	Ecological Integrity Index Pre-Impact	Ecological Integrity Index Post-Impact	Length (ft)	Balance (ft)	Mitigation Reach (MR) Name	Mitigation Work Timing & Risk: Year Started	Year Matured	Failure Risk	Ecological Integrity Index: Pre-Work	Immediately After Work	At Maturity	Mitigation (Length Required)	Mitigation (Length Offered)
HF 17 (ephemeral)	0.25	0.00	684		HF 17 (ephemeral)	2007	2010	60	0.00	0.30	0.34	535	535
Reach Continued	0.25	0.00		0								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!								#DIV/0!	

Outputs

Ecological Integrity Compensation Ratios

Impact Reach vs Mitigation Reach				Ratio (mitigation site feet per impact site foot)
IR vs MR1			>>	0.78
IR vs MR2			(see note 15)	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Instructions

1) Describe the project impacts:

a) Indicate when the impact(s) will take place (i.e., Impact Year)

b) Estimate the Ecological Integrity (EII) prior to project impacts (i.e., Pre-Impact)

c) Predict Ecological Integrity (EII) after the proposed impacts occur (i.e., Post-Impact)

d) Prescribe the length of stream reach represented by this proposed impact

2) Describe the proposed mitigation used to offset proposed impacts:

a) Indicate when the proposed mitigation will take place (i.e., Year Started)

b) Predict when the mitigation project will reach maturity (i.e., Year Matured)

c) Estimate the Risk of Failure for the specific proposed mitigation site and plan

d) Estimate the Ecological Integrity of the proposed mitigation site before any work is done (i.e., Pre-Work), Immediately After Work, and At Maturity

e) Indicate the linear distance of the proposed mitigation offered to offset proposed impacts

f) If necessary, (indicated by a balance > 0 in Column P), continue with additional mitigation sites

User Notes:

1) User only needs to fill out the gray shaded boxes

2) Use a separate spreadsheet for each homogeneous impact reach to be mitigated

Macroinvertebrate Data - Family Level (Riffle Only)

11. Family Taxa Richness	0	# of taxa sampled
12. Family EPT Richness	0	# of EPT species sampled
13. % Ephemeroptera	0	% Mayflies (0-100)
14. % Chironomidae & Oligochaeta	0	% Midges & Worms (0-100)
16. mFBI	0	no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	368	micro/MHOS

APOGEE ENVIRONMENTAL CONSULTANTS LLC

Appendix H

EII Calculation Five Years after Restoration

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: HF-15

Assessment Objectives: Immediately after restored

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.32	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	10	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	2	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	12	no units (0-20)
10. Riparian Width (both combined)	14	no units (0-20)
Total Habitat Score	142	no units

	Subindex
Habitat Integrity	0.53

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: Pond-106

Assessment Objectives: Immediately after restored

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.38	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	17	no units (0-20)	
2. Embeddedness	17	no units (0-20)	
3. Velocity/Depth Regime	10	no units (0-20)	
4. Sediment Deposition	17	no units (0-20)	
5. Channel Flow Status	10	no units (0-20)	
6. Channel Alteration	15	no units (0-20)	
7. Freq. Of Riffles (bends)	20	no units (0-20)	
8. Bank stability (both combined)	18	no units (0-20)	
9. Veg. Protection (both combined)	12	no units (0-20)	
10. Riparian Width (both combined)	14	no units (0-20)	
Total Habitat Score	150	no units	Subindex
Habitat Integrity			0.67
Macroinvertebrate Data - *Genus/species Level*			
11. Genus/species Taxa Richness		# of taxa sampled	
12. Genus/species EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. % Clingers		% Clingers (0-100)	
16. mHBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	500	microMHOs	0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: HF-16

Assessment Objectives: Immediately after restored

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.30	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units	
Enter quantitative or categorical measure from Field Data Sheet in shaded cells			
RBP Habitat Parameters			
1. Epifaunal Substrate	17	no units (0-20)	
2. Embeddedness	17	no units (0-20)	
3. Velocity/Depth Regime	9	no units (0-20)	
4. Sediment Deposition	17	no units (0-20)	
5. Channel Flow Status	1	no units (0-20)	
6. Channel Alteration	15	no units (0-20)	
7. Freq. Of Riffles (bends)	20	no units (0-20)	
8. Bank stability (both combined)	18	no units (0-20)	
9. Veg. Protection (both combined)	12	no units (0-20)	
10. Riparian Width (both combined)	14	no units (0-20)	
Total Habitat Score	140	no units	Subindex
Habitat Integrity			0.50
Macroinvertebrate Data - *Genus/species Level*			
11. Genus/species Taxa Richness		# of taxa sampled	
12. Genus/species EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. % Clingers		% Clingers (0-100)	
16. mHBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	500	microMHOs	0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: Pond-107

Assessment Objectives: *Immediately after restored*

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.38	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	10	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	9	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	12	no units (0-20)
10. Riparian Width (both combined)	14	no units (0-20)
Total Habitat Score	149	*no units*

			Subindex
Habitat Integrity			0.65

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled	
12. Genus/species EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. % Clingers		% Clingers (0-100)	
16. mHBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	500	microMHOs	0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: HF-17

Assessment Objectives: Immediately after restored

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.30	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	0	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	12	no units (0-20)
10. Riparian Width (both combined)	14	no units (0-20)
Total Habitat Score	139	no units

	Subindex
Habitat Integrity	0.49

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: Pond-92

Assessment Objectives: *Immediately after restored*

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.30	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	0	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	12	no units (0-20)
10. Riparian Width (both combined)	14	no units (0-20)
Total Habitat Score	139	no units

	Subindex
Habitat Integrity	0.49

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Appendix I

EII Calculation for 30 Years after Disturbance

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: HF-15

Assessment Objectives: 30 Years Post Disturbanc

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.37	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	10	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	2	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	14	no units (0-20)
10. Riparian Width (both combined)	18	no units (0-20)
Total Habitat Score	148	no units

	Subindex
Habitat Integrity	0.63

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: Pond-106

Assessment Objectives: 30 Years Post Disturbanc

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.43	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	10	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	10	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	14	no units (0-20)
10. Riparian Width (both combined)	18	no units (0-20)
Total Habitat Score	156	no units

	Subindex
Habitat Integrity	0.77

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled	
12. Genus/species EPT Richness		# of EPT species sampled	
13. % Ephemeroptera		% Mayflies (0-100)	
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)	
15. % Clingers		% Clingers (0-100)	
16. mHBI		no units	
Macroinvertebrate Bioassessment	NA	no units	NA
Conductivity	500	microMHOs	0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: HF-16

Assessment Objectives: 30 Years Post Disturbanc

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.35	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	1	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	14	no units (0-20)
10. Riparian Width (both combined)	18	no units (0-20)
Total Habitat Score	146	no units

	Subindex
Habitat Integrity	.60

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA	
0.10	

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: Pond-107

Assessment Objectives: 30 Years Post Disturbanc

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.43	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	10	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	9	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	14	no units (0-20)
10. Riparian Width (both combined)	18	no units (0-20)
Total Habitat Score	155	no units

	Subindex
Habitat Integrity	75

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: HF-17

Assessment Objectives: 30 Years Post Disturbanc

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.34	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	0	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	14	no units (0-20)
10. Riparian Width (both combined)	18	no units (0-20)
Total Habitat Score	145	no units

	Subindex
Habitat Integrity	0.58

Macroinvertebrate Data - *Genus/species Level*

11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Project ID: Nally & Hamilton (Permit No. 860-0380, Am #6)

Stream/Reach: Pond-92

Assessment Objectives: 30 Years Post Disturbanc

NA	Ecological Integrity Index (MBI + Habitat Integrity + Conductivity)		
0.34	Ecological Integrity Index (Habitat Integrity + Conductivity)		

Variables	Measure	Units

Enter quantitative or categorical measure from Field Data Sheet in shaded cells

RBP Habitat Parameters

1. Epifaunal Substrate	17	no units (0-20)
2. Embeddedness	17	no units (0-20)
3. Velocity/Depth Regime	9	no units (0-20)
4. Sediment Deposition	17	no units (0-20)
5. Channel Flow Status	0	no units (0-20)
6. Channel Alteration	15	no units (0-20)
7. Freq. Of Riffles (bends)	20	no units (0-20)
8. Bank stability (both combined)	18	no units (0-20)
9. Veg. Protection (both combined)	14	no units (0-20)
10. Riparian Width (both combined)	18	no units (0-20)
Total Habitat Score	145	no units

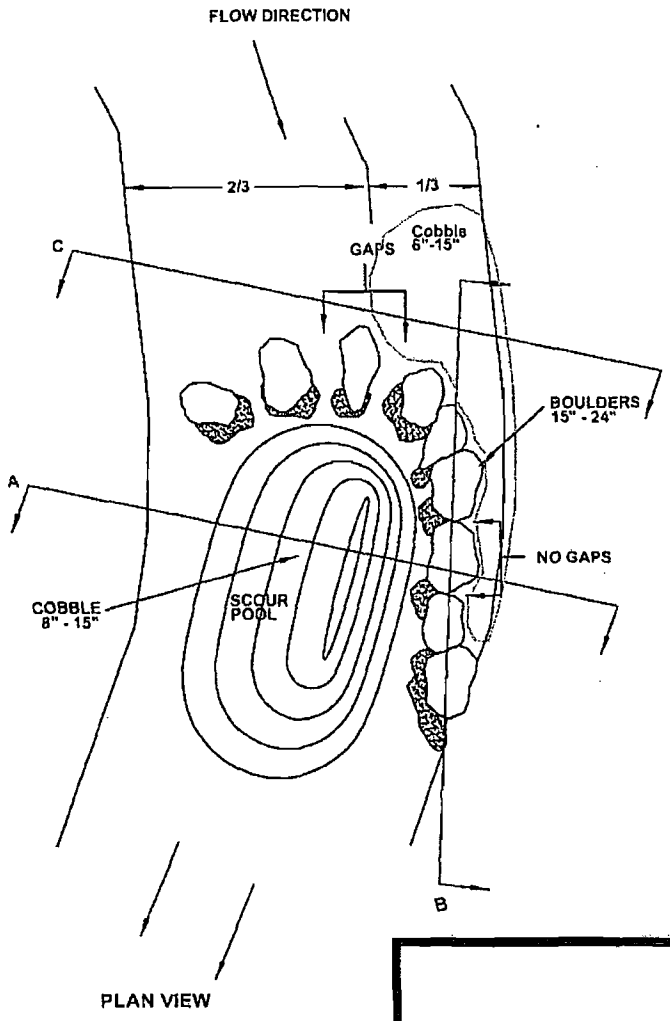
	Subindex
Habitat Integrity	0.58

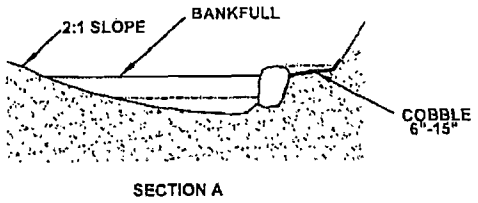
Macroinvertebrate Data - *Genus/species Level*

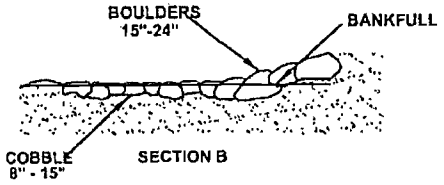
11. Genus/species Taxa Richness		# of taxa sampled
12. Genus/species EPT Richness		# of EPT species sampled
13. % Ephemeroptera		% Mayflies (0-100)
14. % Chironomidae & Oligochaeta		% Midges & Worms (0-100)
15. % Clingers		% Clingers (0-100)
16. mHBI		no units
Macroinvertebrate Bioassessment	NA	no units
Conductivity	500	microMHOs

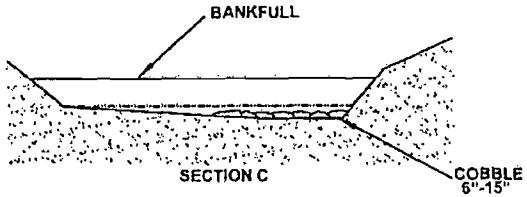
NA
0.10

APOGEE ENVIRONMENTAL CONSULTANTS, LLC









J-Hook

-NTS-

APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

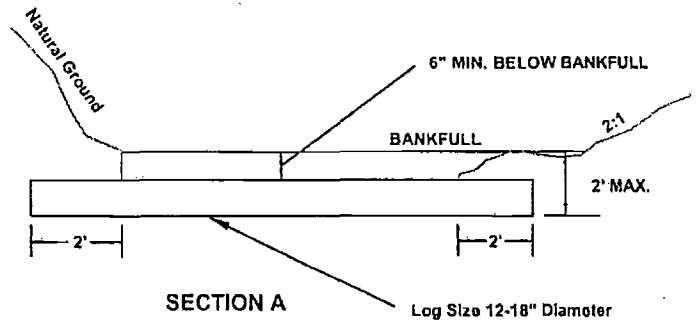
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

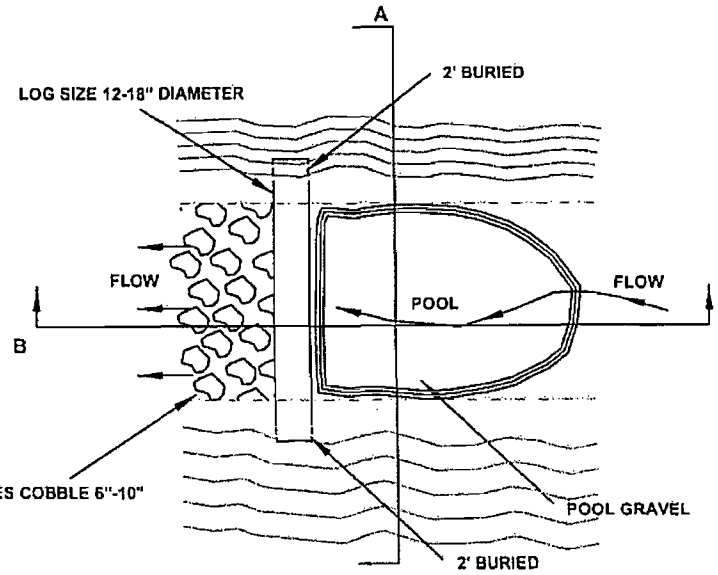
NALLY & HAMILTON ENTERPRISES, INC.

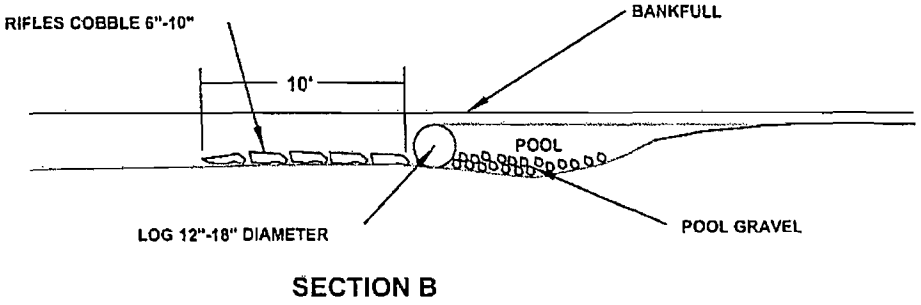
J-HOOK DIAGRAM
Attachment 1

SCALE:

11/15/05







Log Vane

-NTS-

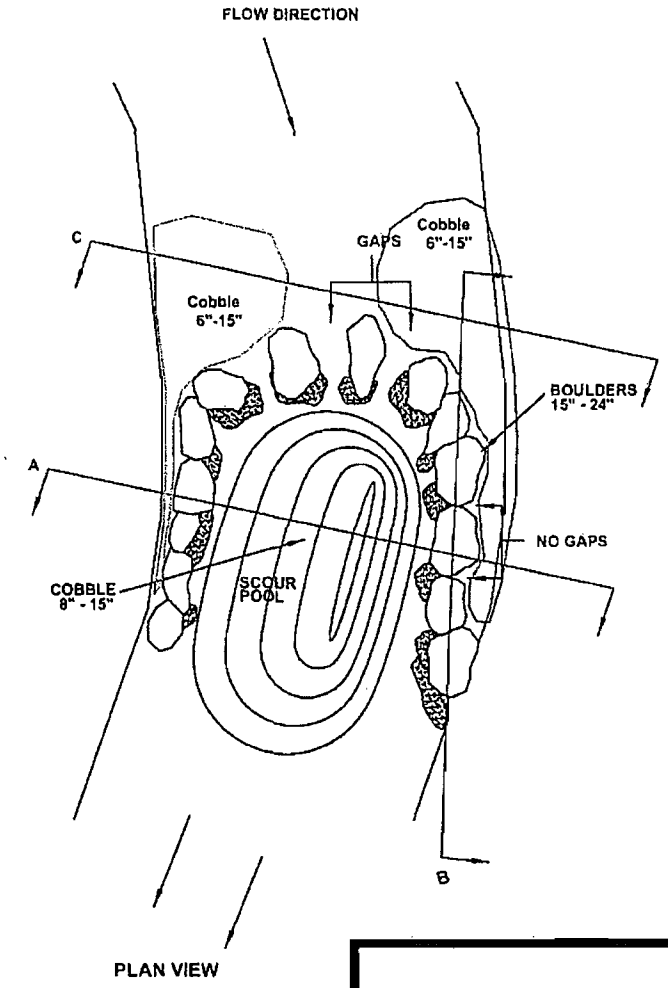
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

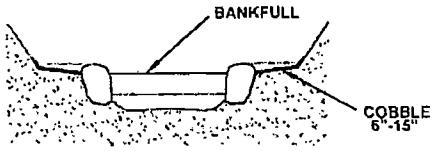
NALLY & HAMILTON ENTERPRISES, INC.

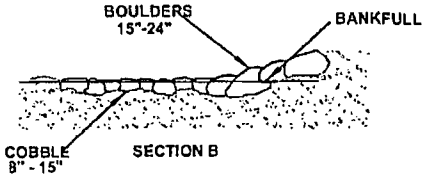
VANE DIAGRAM
Attachment 2

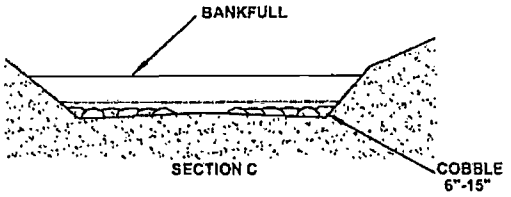
SCALE:

11/15/05









Rock Vane

-NTS-

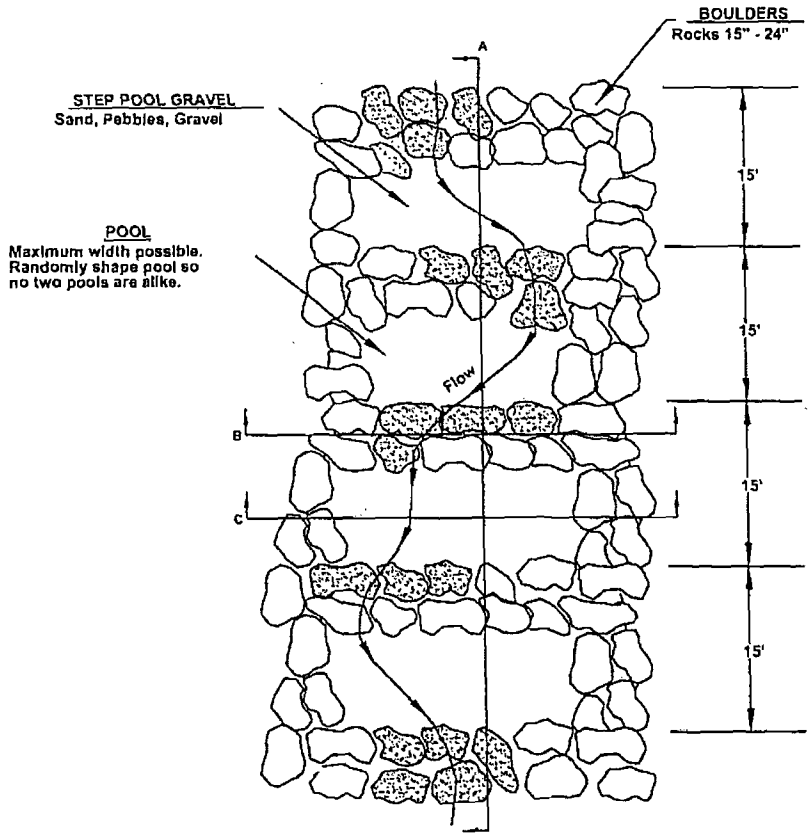
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

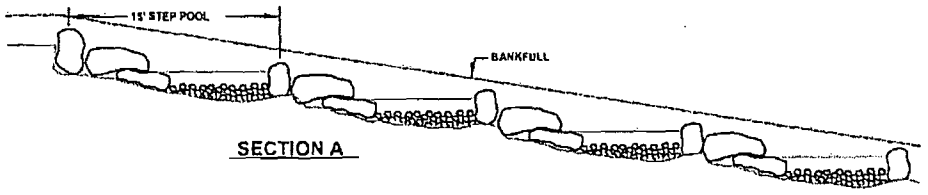
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERKPRISES, INC.

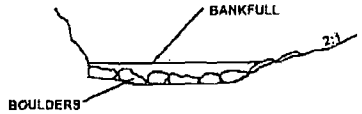
VANE DIAGRAM
Attachment 3

SCALE:	11/15/05

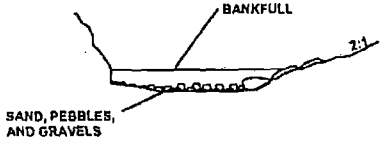




SECTION A



SECTION B



SECTION C

Step Pool

-NTS-

APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

STEP POOL DIAGRAM
Attachment 4

SCALE:

11/15/05

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Longitudinal Profile Data Sheet – POND 107-AS

Project # _____ **Project Name** 860-0390 MOD #5

Stream/Drainage SUGAR BRANCH **Date** 11-10-05

GPS: N 37° 14' 01.1" **W** 83° 01' 32.3"

County KNOTT **State** KY **Quad** BLACKEY

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
1	0	89.0	RIFFLE	DRY	
2	8.86	89.6	RIFFLE	↑	4
3	22.02	90.4	RIFFLE	|	
4	31.51	90.9	RIFFLE	|	
5	37.86	90.7	POOL	|	
6	43.96	91.6	POOL	|	6
7	48.58	91.6	POOL	|	
8	53.12	92.7	RIFFLE	|	
9	69.37	93.2	RIFFLE	|	
10	87.47	93.9	RIFFLE	|	
11	101.76	94.8	RIFFLE	|	
12	128.56	96.7	RIFFLE	|	
13	149.91	97.3	RIFFLE	↓	
14	159.17	98.3	RIFFLE	DRY	
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Longitudinal Profile Data Sheet HOLLOW FILL 16-A5

Project # _____ **Project Name** B60-0380 ADM PS

Stream/Drainage SUGAR BRANCH **Date** 11-10-05

GPS: N 37° 14' 01.1" **W** 83° 01' 32.3"

County KNOTT **State** KY **Quad** BLACKEY

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
1	0	98.3	RIFFLE	DRY	
2	20.68	99.2	RIFFLE	↑	
3	43.00	100.1	POOL	|	
4	62.64	101.4	POOL	↓	3
5	70.24	103.3	RIFFLE	DRY	
6	93.16	104.8	POOL	2"	
7	97.74	104.1	RIFFLE	DRY	
8	110.20	105.6	RIFFLE	↑	
9	124.54	110.3	RIFFLE	|	
10	142.44	113.6	RIFFLE	↓	
11	162.32	119.8	RIFFLE	DRY	
12	176.04	120.0	RIFFLE	SHEET FLOW	
13	192.90	124.3	POOL	3"	6
14	209.88	124.7	RIFFLE	SHEET FLOW	
15	212.20	126.3	RIFFLE	SHEET FLOW	
16	230.57	127.8	RIFFLE	SHEET FLOW	
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet – POND 107-AS

Project # _____ Project Name 860-0380 ADM #5

Stream/Drainage SUGAR BRANCH Date 11-10-05

GPS: N 37°14'01.1" W 83°01'32.3"

County KNOTT State KY Quad BLACKEY

Feature Surveyed [X] riffle [ ] pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0	98.0	HILL
2	5.73	96.7	TOP OF BANK
3	6.92	94.7	CHANNEL
4	11.12	94.7	CHANNEL
5	12.38	95.2	BANKFUL
6	15.07	95.3	BOTTOM OF BANK
7	20.99	97.7	TOP OF BANK
8	31.43	98.3	HILL
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet -HOLLOWFILL 16-AS

Project # _____ Project Name 860-0380 AOM #5

Stream/Drainage SUGAR BRANCH Date 11-10-05

GPS: N 37° 14' 01.1" W 83° 01' 32.3"

County KNOTT State KY Quad BLACKEY

Feature Surveyed [X] riffle [ ] pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0	112.4	HILL
2	8.39	106.1	BOTTOM BANK
3	10.54	106.1	TOP OF BANK
4	11.86	104.3	CHANNEL
5	17.72	103.4	THALWEG
6	19.75	103.8	CHANNEL
7	20.94	104.8	BANKFULL
8	22.97	106.2	TOP OF BANK
9	29.33	109.7	HILL
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Stream Channel Classification (Level II) ...

Stream NAME: UNNAMED TRIB TO BEECHMEL CREEK

Basin NAME: HOLLOW FILL 17-AE Drainage AREA: 27.3 acre _____ mi²

Location: _____

Twp: _____ Rge: _____ Sec: _____ Qtr: _____ Lat: _____ Long: _____

Observers: _____ Date: 1-11-06

Bankfull WIDTH (W_{bkf}) 3.3 Feet

WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 0.25 Feet

Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf}=A_{bkf}/W_{bkf}$)

Bankfull Cross Section Area (A_{bkf}) 0.59 Feet²

AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

WIDTH / DEPTH RATIO (W_{bkf}/d_{bkf}) 13.2 Ft/Ft

Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 0.34 Feet

Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 4.4 Feet

Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.

Entrenchment Ratio (ER) 1.33 Ft/Ft

The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa}/W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 _____ mm

The D50 particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) 26.6% Ft/Ft

Channel slope = "rise over run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) 1.18

Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/ S).

Stream Type

* For Reference, see page 5-5, 5-6: Rosgen, 1996. Applied River Morphology.

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Pebble Count Data Sheet – Hollow Fill 17-06

Project # _____ **Project Name** MUH ADM 6

Stream/Drainage UNNAMED TRIB BEEDAL CK **Date** 1-11-06

GPS: N _____ **W** _____

County KNOTT **State** KY **Quad** _____

Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)
0	12	26	SAND	52		78	
1	25	27	9	53		79	
2	165	28	250	54		80	
3	44	29	30	55		81	
4	225	30	27	56		82	
5	134	31	254	57		83	
6	42 COAL	32	435	58		84	
7	32 COAL	33	95	59		85	
8	57	34	120	60		86	
9	10	35	28	61		87	
10	87	36	135	62		88	
11	66	37	14	63		89	
12	73	38	22	64		90	
13	55	39	186	65		91	
14	11	40	55	66		92	
15	27 COAL	41	77	67		93	
16	21	42	136	68		94	
17	75	43	160	69		95	
18	96	44	170	70		96	
19	17	45	19	71		97	
20	31	46	102	72		98	
21	16	47	56	73		99	
22	122	48	157	74		100	
23	66	49	170	75			
24	80	50	44	76			
25		51	83	77			

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Longitudinal Profile Data Sheet - Hollow Fill 17 AG

Project # 05-104.00 **Project Name** MVH ROM 6

Stream/Drainage UNNAMED TRIB BEECHLICK **Date** 1-11-06

GPS: N 37°14'40.9" **W** 82°01'58.5"

County KNOTT **State** KY **Quad** Blackey

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
1	0	92.6	RIFFLE	DRY	
2	9.1	93.5	RIFFLE	↑	
3	17.7	95.4	RIFFLE		
4	22.8	97.4	RIFFLE		
5	29.5	99.4	RIFFLE		
6	31.0	98.4	POOL		3"
7	35.8	91.3	RIFFLE		
8	38.3	91.3	POOL		
9	42.4	93.8	RIFFLE		
10	64.3	97.5	RIFFLE		
11	71.0	100.2	RIFFLE		
12	89.8	102.0	RIFFLE		
13	97.2	105.4	RIFFLE		
14	102.1	106.1	RIFFLE		
15	104.1	107.0	RIFFLE		
16	105.6	107.1	POOL		
17	109.0	109.4	RIFFLE		
18	112.7	110.5	RIFFLE		
19	117.1	111.8	RIFFLE		
20	131.2	113.9	RIFFLE		
21	135.9	116.4	RIFFLE		
22	140.6	117.0	RIFFLE		
23	143.1	116.7	POOL		3"
24	145.3	118.2	RIFFLE		
25	157.5	120.5	RIFFLE		
26	159.6	120.3	POOL		
27	168.6	124.4	RIFFLE		
28	175.3	125.0	RIFFLE		
29	177.0	124.7	POOL	↓	
30	183.1	127.5	RIFFLE	DRY	

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Hollow Fill 17-A6 cont...

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
31	214.3	135.2	RIFFLE	DRY	
32	227.8	132.4	RIFFLE	↑	
33	234.7	141.0	RIFFLE	|	
34	244.1	143.4	RIFFLE	|	
35	246.1	143.3	Pool	|	
36	262.0	151.2	RIFFLE	|	
37	270.2	153.7	RIFFLE	|	
38	285.4	163.5	RIFFLE	V	
39	297.0	164.2	RIFFLE	DRY	
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet - HOLLOW FTL 17-A6

Project # 05-104.00 Project Name MOH MOM. 6

Stream/Drainage UNNAMED TRIB BREEDING CK Date 1-11-06

GPS: N 37°14'40.9" W 83°01'58.5"

County Knott State Ky Quad Blackey

Feature Surveyed ☐ riffle ☒ pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0	119.7	AGG
2	1.9	117.4	TOP OF BANK
3	3.4	117.0	BANK FULL
4	4.8	116.8	THALWEG
5	5.7	116.9	CHANNEL
6	7.4	118.2	TOP OF BANK
7	19.7	118.6	TOP OF BANK
8	24.1	117.0	THALWEG
9	29.1	120.7	HILL
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet - Hollow Fill 17-176

Project # 05-104.00 Project Name NSH ADM 6

Stream/Drainage Unnamed Trib Blowing Ck Date 1-11-06

GPS: N 37°14'40.9" W 83°01'58.5"

County Knott State Ky Quad Blackey

Feature Surveyed [X] riffle [ ] pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0	109.0	HILL
2	5.2	106.7	BANKFULL
3	6.4	105.8	THALWEG
4	7.9	105.5	CHANNEL
5	9.8	105.8	TOP OF BANK
6	11.8	107.1	TOP OF BANK
7	21.9	107.3	CHANNEL
8	23.1	106.5	BOTTOM OF BANK / CHANNEL
9	25.8	107.0	TOP OF BANK
10	29.2	109.1	HILL
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Stream Channel Classification (Level II)

Stream NAME: UNNAMED TRIB TO DEFEATED CREEK

Basin NAME: Pond 92-A6 Drainage AREA: 51.6 acre _____ mi²

Location: Knott County

Twp: _____ Rge: _____ Sec: _____ Qtr: _____ Lat: _____ Long: _____

Observers: _____ Date: _____

Bankfull WIDTH (W_{bkf}) 1.3 Feet
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 0.25 Feet
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf}=A_{bkf}/W_{bkf}$)

Bankfull Cross Section Area (A_{bkf}) 2.98 Feet²
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

WIDTH / DEPTH RATIO (W_{bkf}/d_{bkf}) 5.2 Ft/Ft
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 0.36 Feet
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 19.9 Feet
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.

Entrenchment Ratio (ER) 15.31 Ft/Ft
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa}/W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 _____ mm
The D50 particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) 26.7 Ft/Ft %
Channel slope = "rise over run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) 1.12
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/ S).

Stream Type _____

For Reference, see page 5-5, 5-6: Rosgen, 1996. Applied River Morphology.

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Pebble Count Data Sheet

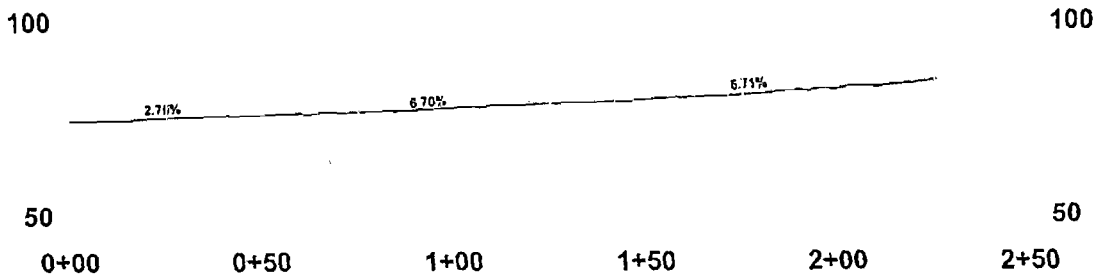
Project # _____ Project Name Lick Branch

Stream/Drainage Lick Fork / Middle Fork KY Date _____

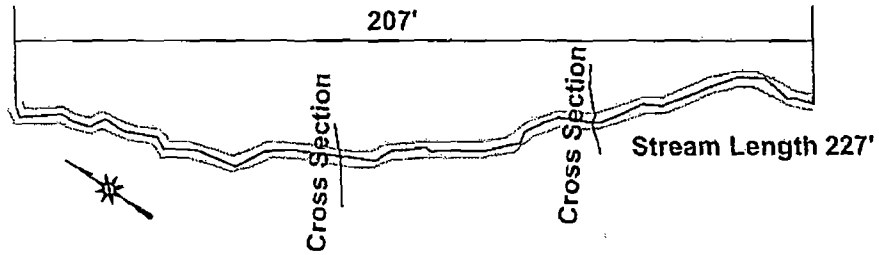
GPS: N _____ W _____

County Leslie State KY Quad Hoskinston

Point (m)	Pebble size (mm)		Point (m)	Pebble size (mm)		Point (m)	Pebble size (mm)		Point (m)	Pebble size (mm)	
0	silt	R	30	sand	R	60	345	P	90	27	R
1	silt	R	31	28	R	61	87	R	91	25	R
2	silt	R	32	sand	R	62	133	P	92	sand	R
3	18	P	33	16	R	63	sand	P	93	300	R
4	20	P	34	68	R	64	35	R	94	80	P
5	6	P	35	16	R	65	9	R	95	37	R
6	sand	P	36	5	P	66	50	R	96	20	R
7	12	P	37	75	P	67	100	P	97	69	R
8	510	P	38	20	R	68	120	R	98	40	R
9	118	P	39	107	R	69	15	R	99	27	R
10	14	R	40	115	R	70	32	R	100	26	R
11	10	R	41	24	R	71	95	R	101		
12	sand	R	42	4	P	72	890	R	102		
13	40	R	43	45	R	73	120	R	103		
14	sand	R	44	27	R	74	32	R	104		
15	sand	R	45	23	R	75	90	R	105		
16	25	R	46	25	R	76	92	R	106		
17	7	P	47	70	R	77	50	R	107		
18	sand	P	48	sand	R	78	28	R	108		
19	sand	P	49	300	R	79	sand	P	109		
20	28	R	50	15	R	80	1200	R	110		
21	5	R	51	18	P	81	75	R	111		
22	44	R	52	82	P	82	72	R	112		
23	23	R	53	85	R	83	30	P	113		
24	18	R	54	120	R	84	120	R	114		
25	25	R	55	130	R	85	140	P	115		
26	26	R	56	20	R	86	sand	R	116		
27	35	R	57	65	P	87	38	R	117		
28	sand	R	58	18	R	88	25	R	118		
29	70	R	59	7	P	89	77	R	119		



Profile



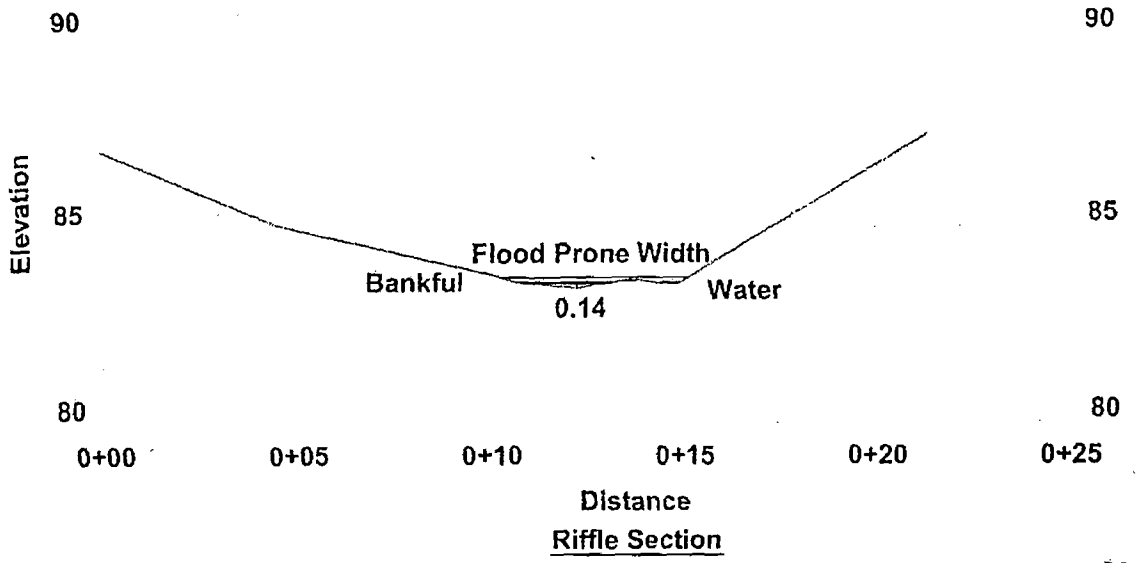
Sinuosity

APOGEE
ENVIRONMENTAL CONSULTANTS, INC.
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

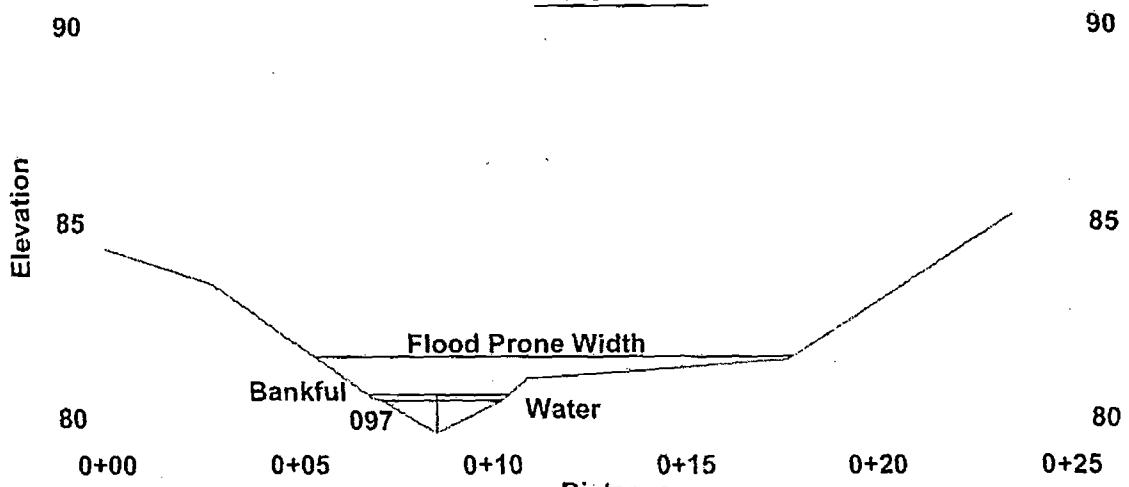
NALLY & HAMILTON ENTERPRISES, INC.

Typical longitudinal profile of five to seven percent sloped stream, Leslie County, Kentucky.

SCALE: 1"=50' 10/14/05



Riffle Section



Pool Section

APOGEE
ENVIRONMENTAL CONSULTANTS, INC.
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Typical cross section
for five to seven percent grade stream,
Leslie County, Kentucky.

SCALE: 1"=5' 10/14/05

Appendix F

Stream Compensation Ratio Calculator Forms

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Pebble Count Data Sheet – Hollow Fill 2

Project # 05.02 Project Name Carr Creek 404

Stream/Drainage Unnamed Trib. To Carr Creek Date 10/6/03

GPS: N 37d14'02.4" W 82d56'25.0"

County Knott State KY Quad Blackey

Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)
0	Sand	26	138	52	111	78	17
1	13	27	8	53	11	79	55
2	87	28	245	54	16	80	Sand
3	90	29	378	55	13	81	Sand
4	161	30	34	56	3	82	100
5	103	31	490	57	12	83	8
6	Clay	32	60	58	Sand	84	195
7	285	33	Sand	59	325	85	75
8	53	34	Clay	60	15	86	41
9	290	35	Clay	61	31	87	55
10	36	36	3	62	355	88	Sand
11	58	37	37	63	23	89	13
12	15	38	1020	64	137	90	42
13	Sand	39	465	65	34	91	62
14	57	40	9	66	91	92	25
15	6	41	90	67	140	93	86
16	63	42	Sand	68	105	94	Sand
17	3	43	7	69	48	95	Sand
18	800	44	25	70	17	96	33
19	Sand	45	11	71	405	97	2
20	2	46	68	72	41	98	215
21	Sand	47	22	73	2	99	9
22	5	48	25	74	480	100	21
23	87	49	50	75	34		
24	105	50	125	76	46		
25	46	51	87	77	70		

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet – Hollow Fill 2 22.9m

Project # 05.02 Project Name Carr Creek 404

Stream/Drainage Unnamed Trib. To Carr Creek Date 10/8/03

GPS: N 37d14'02.1" W 82d56'24.2"

County Knott State KY Quad Blackey

Feature Surveyed [X] riffle [ ] pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0'0"	97.55	
2	6'3"	93.50	Top of Bank
3	6'7"	93.20	Bankfull
4	7'8"	92.55	Channel Dry
5	9'4"	92.35	Thalwag
6	12'4"	92.60	Channel Dry
7	14'1"	93.80	Top of Bank
8	16'10"	94.95	
9	26'8"	95.85	
10	32'8"	99.45	
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet – Hollow Fill 2 89.0m

Project # 05.02 Project Name Carr Creek 404

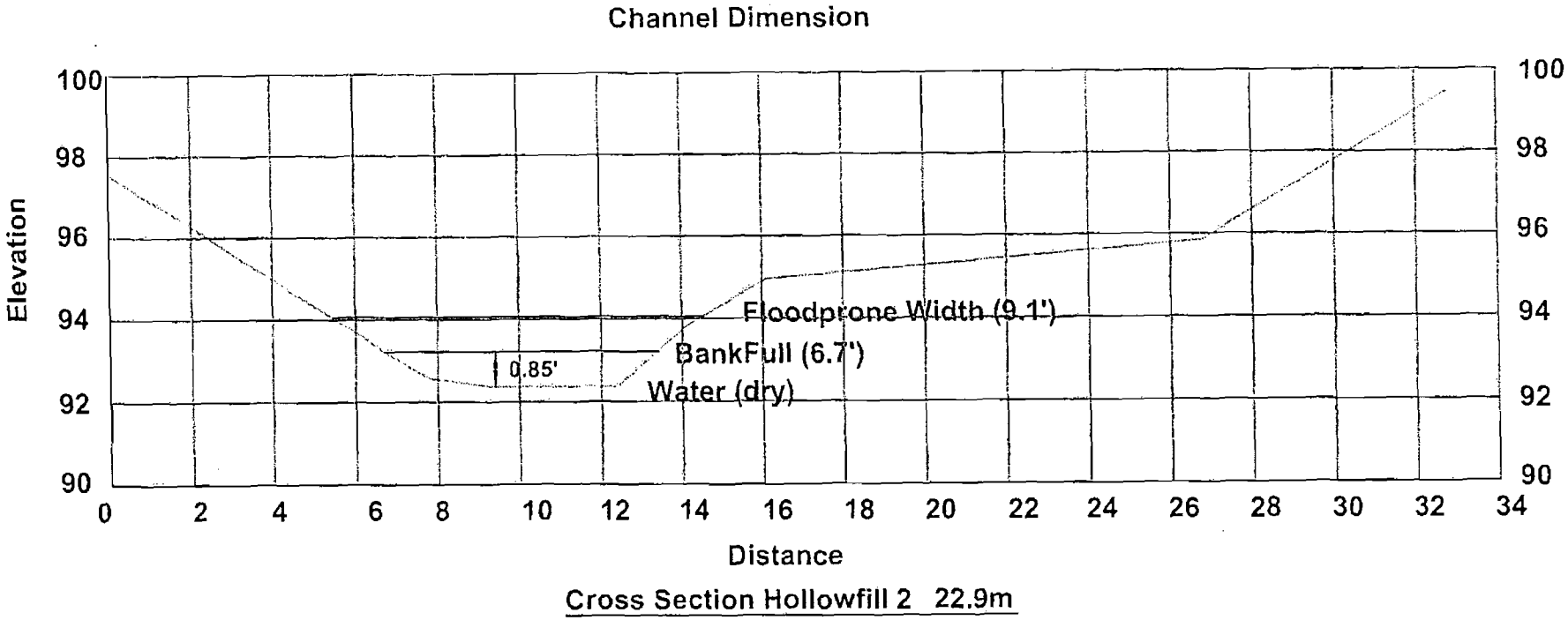
Stream/Drainage Unnamed Trib. To Carr Creek Date 10/8/03

GPS: N 37d14'00.5" W 82d56'23.1"

County Knott State KY Quad Blackey

Feature Surveyed [X] riffle [ ] pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0'0"	98.90	
2	4'2"	96.90	
3	6'9"	96.50	Top of Bank
4	8'4"	94.85	Bankfull
5	9'6"	94.17	Channel Dry
6	13'3"	94.37	
7	15'7"	93.86	Thalwag
8	18'7"	95.10	Channel Dry
9	21'3"	96.63	Top of Bank
10	27'9"	95.00	
11	32'0"	95.32	
12	35'6"	94.78	Top of Bank
13	38'1"	92.50	Bankfull
14	38'7"	92.05	Channel Dry
15	41'0"	90.20	Thalwag
16	42'11"	92.00	Channel Dry
17	44'3"	94.55	Top of Bank
18	47'0"	96.20	
19			
20			
21			
22			
23			
24			
25			



Cross Section Hollowfill 2 22.9m

Apogee
ENVIRONMENTAL CONSULTANTS, LLC
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Riffle Cross Section
at Unnamed Trib. to Carr Creek Lake
Knott County, Kentucky

SCALE: 1"=4' 6/21/04

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet – Hollow Fill 2 46.0m

Project # 05.02 Project Name Carr Creek 404

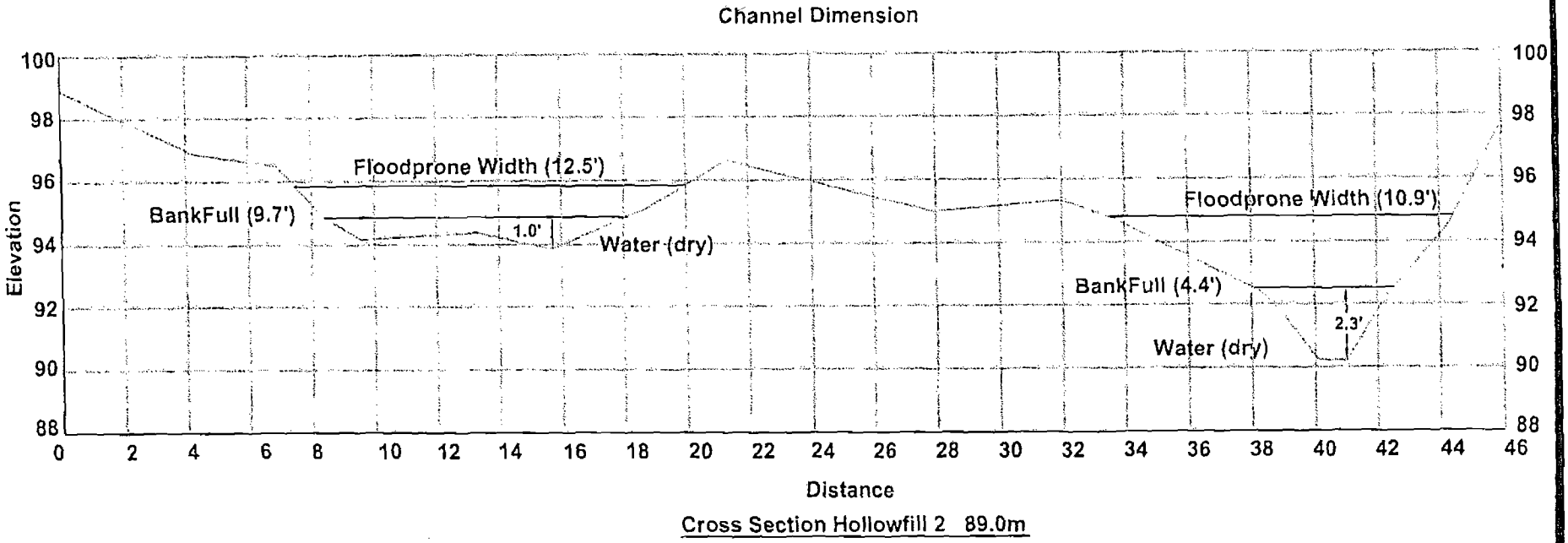
Stream/Drainage Unnamed Trib. To Carr Creek Date 10/8/03

GPS: N 37d14'01.6" W 82d56'23.6"

County Knott State KY Quad Blackey

Feature Surveyed ☐ riffle ☒ pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0'0"	99.62	
2	6'8"	95.18	Small Channel Dry
3	10'5"	94.55	Thalwag
4	12'6"	95.46	Top of Bank
5	16'10"	95.51	
6	20'3"	94.61	
7	28'8"	93.95	Top of Bank
8	31'8"	90.02	Thalwag
9	33'6"	90.07	Middle Channel
10	36'3"	90.80	Channel Dry
11	37'0"	91.46	Bankfull
12	39'0"	95.30	Top of Bank
13	44'0"	98.00	
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			



Cross Section Hollowfill 2 89.0m

Apogee
ENVIRONMENTAL CONSULTANTS, LLC
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Riffle Cross Section
at Unnamed Trib. to Carr Creek Lake
Knott County, Kentucky

SCALE: 1"=5' 6/21/04

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet – Hollow Fill 2 151.8m

Project # 05.02 Project Name Carr Creek 404

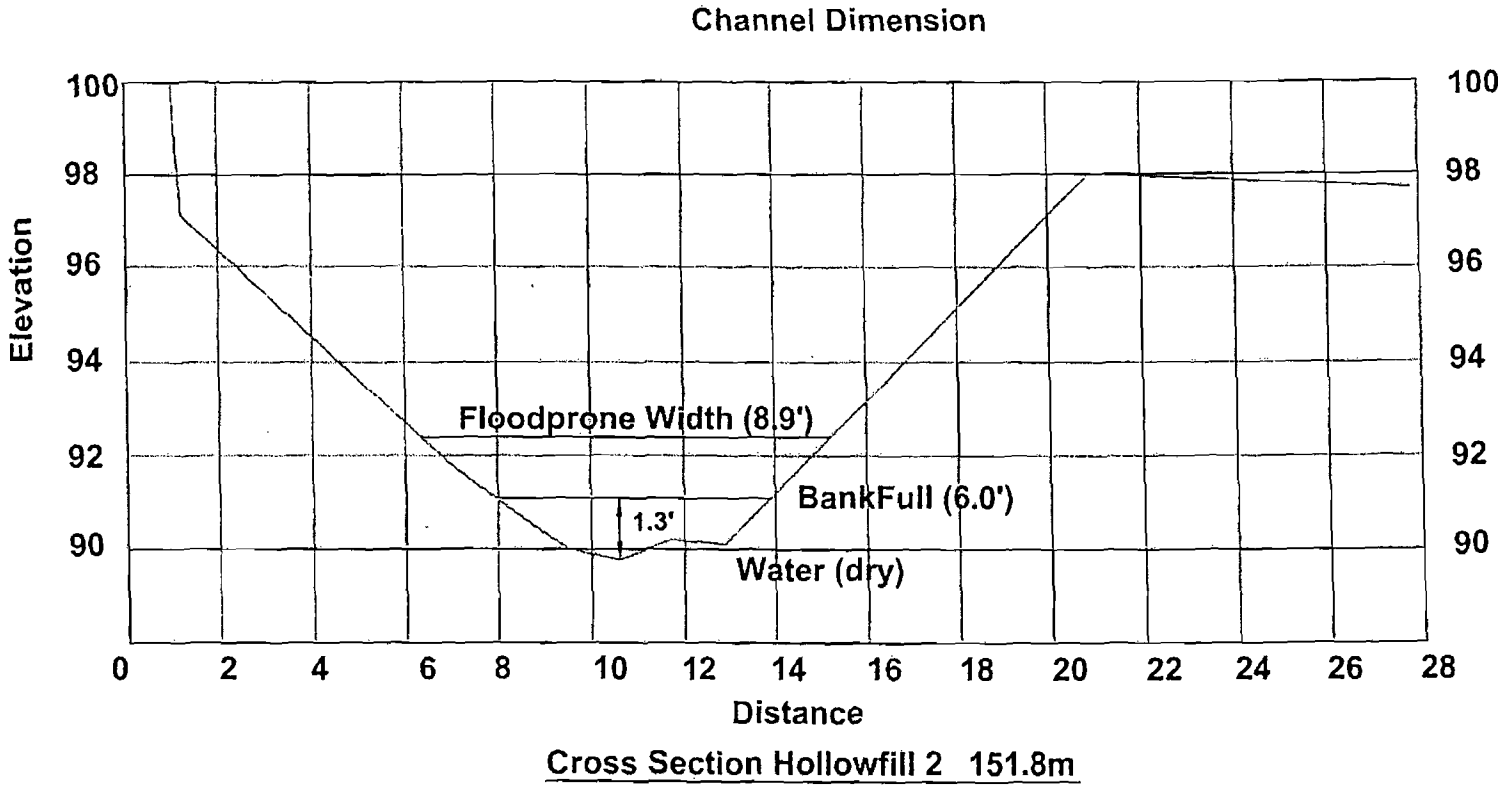
Stream/Drainage Unnamed Trib. To Carr Creek Date 10/8/03

GPS: N 37d13'59.4" W 82d56'21.2"

County Knott State KY Quad Blackey

Feature Surveyed ☐ riffle ☒ pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0'9"	100.00	
2	1'2"	97.10	
3	6'10"	91.90	Top of Bank
4	7'11"	91.10	Bankfull
5	9'5"	89.95	Edge of Water
6	10'6"	89.77	Thalwag
7	11'7"	90.20	Edge of Water
8	12'9"	90.11	Channel
9	20'9"	98.00	Top of Bank
10	27'8"	97.70	
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			



Cross Section Hollowfill 2 151.8m

Appalee
ENVIRONMENTAL CONSULTANTS, LLC
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

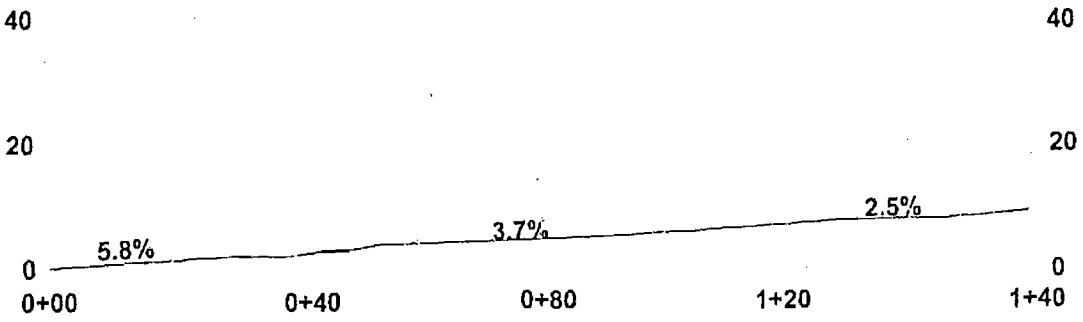
NALLY & HAMILTON ENTERPRISES, INC.

Pool Cross Section
at Unnamed Trib. to Carr Creek Lake
Knott County, Kentucky

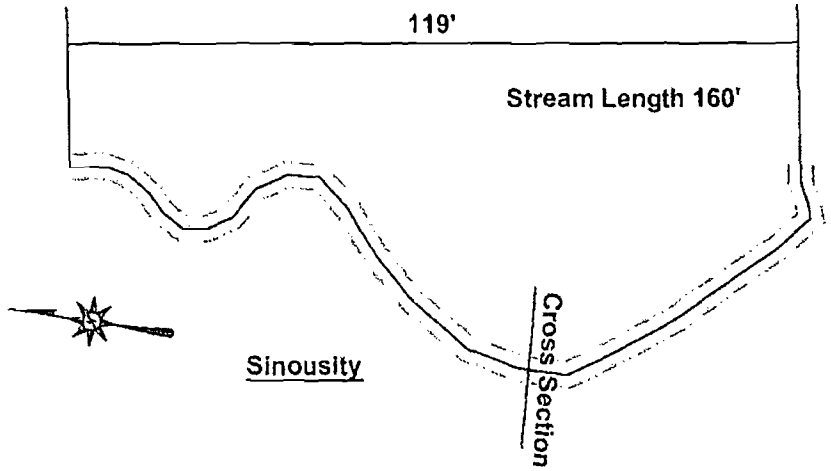
SCALE: 1"=4' 6/21/04

Appendix D

Longitudinal Profile, Cross Sections, and Pebble Counts for Streams to be Disturbed at Proposed Project Area



Profile



Sinousity

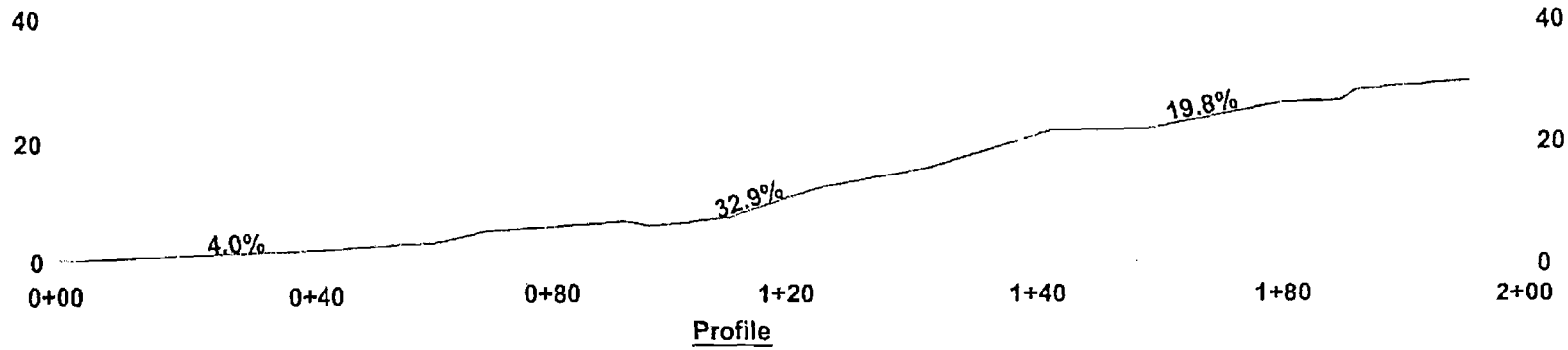
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

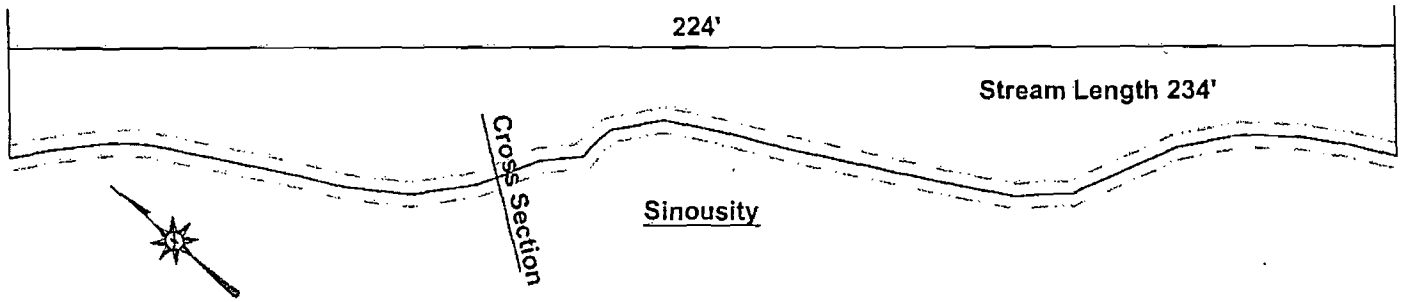
NALLY & HAMILTON ENTERPRISES, INC.

Longitudinal Profile
of Pond 107-A5
Knott County, Kentucky.

SCALE: 1"=30' 11/15/05



Profile



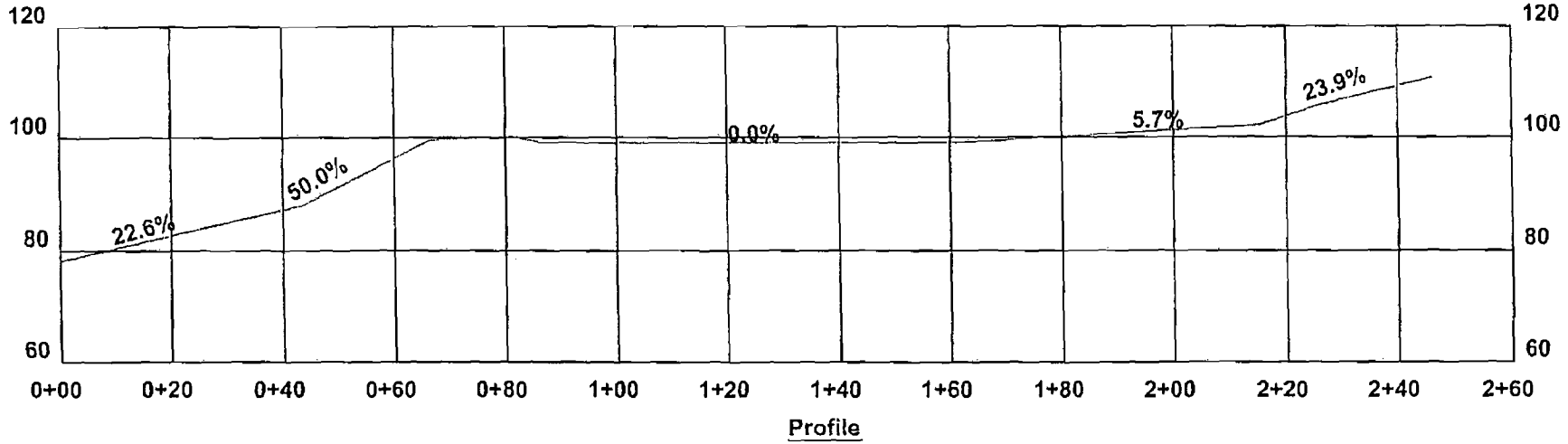
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

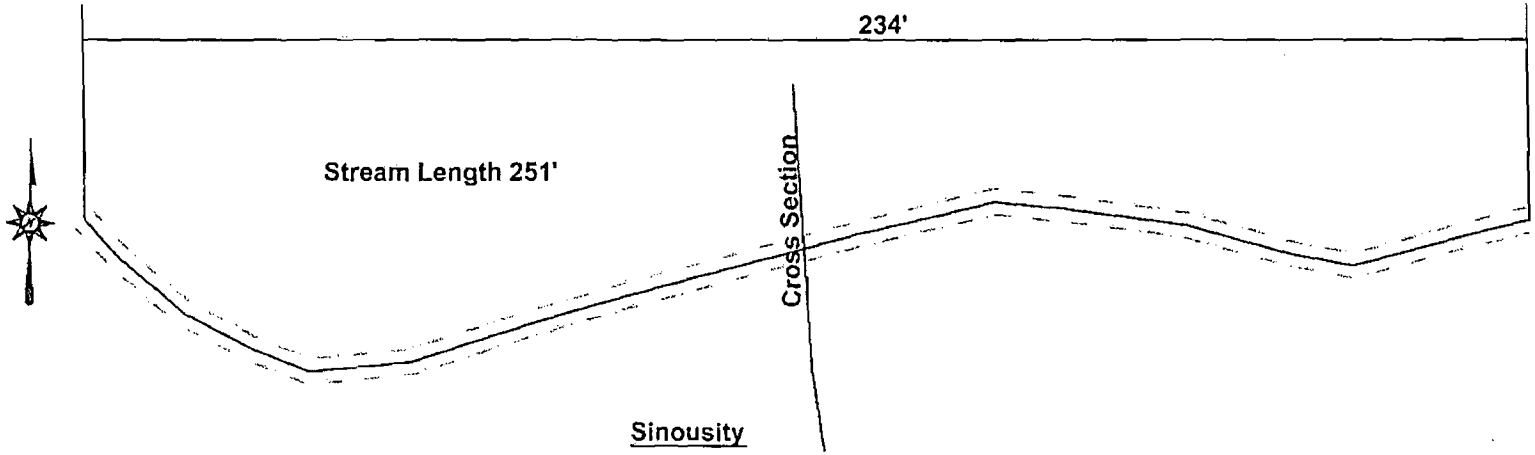
NALLY & HAMILTON ENTERPRISES, INC.

Longitudinal Profile
of Hollow Fill 16-A5
Knott County, Kentucky.

SCALE:	1"=30'	11/15/05



Profile



Sinousity

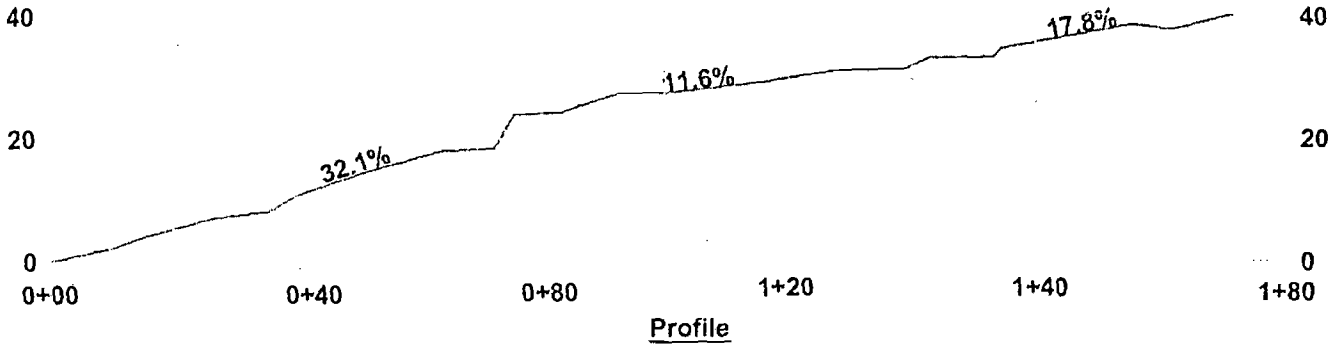
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

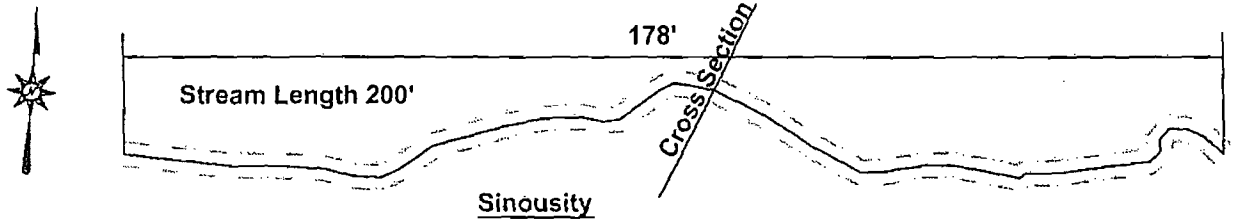
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Longitudinal Profile
of Pond 106-A5
Knott County, Kentucky.

SCALE: 1"=30' 11/15/05



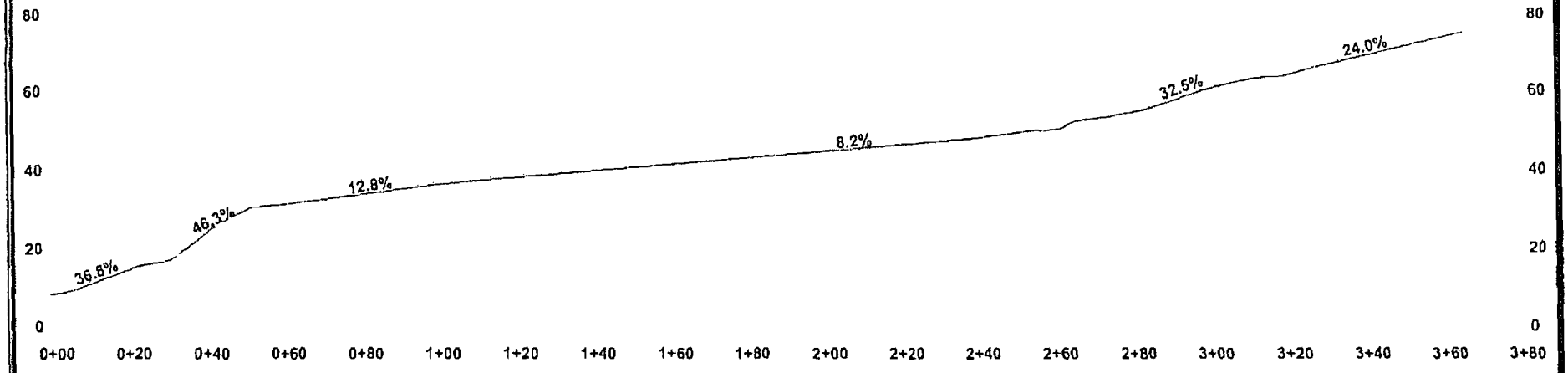


APOGEE
ENVIRONMENTAL CONSULTANTS, INC.
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

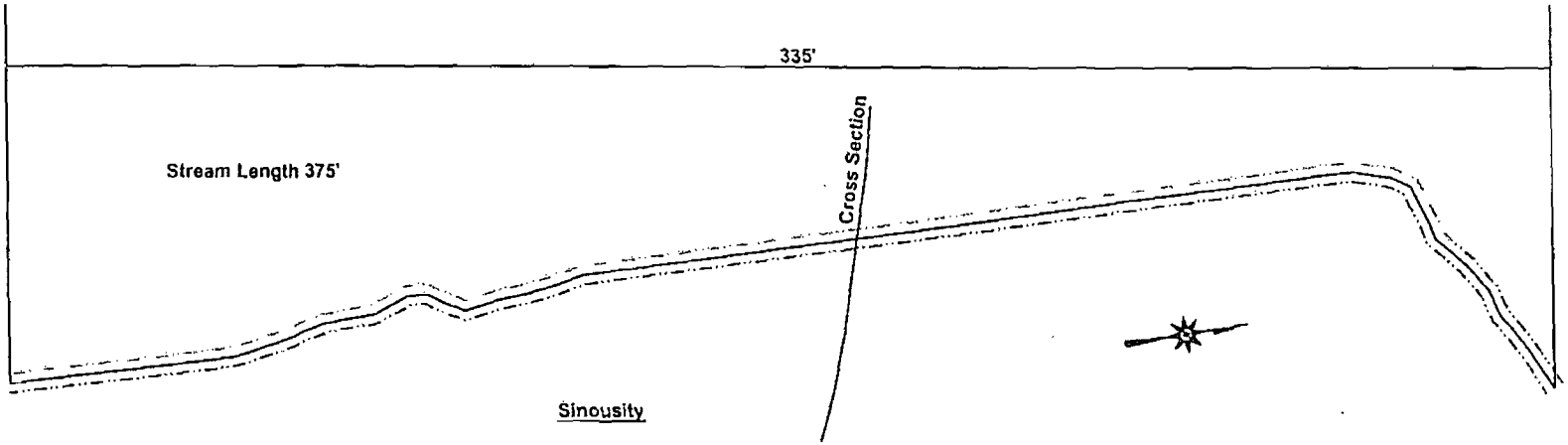
NALLY & HAMILTON ENTERPRISES, INC.

Longitudinal Profile
of Hollow Fill 15-A5
Knott County, Kentucky.

SCALE: 1"=30' 11/15/05



Profile



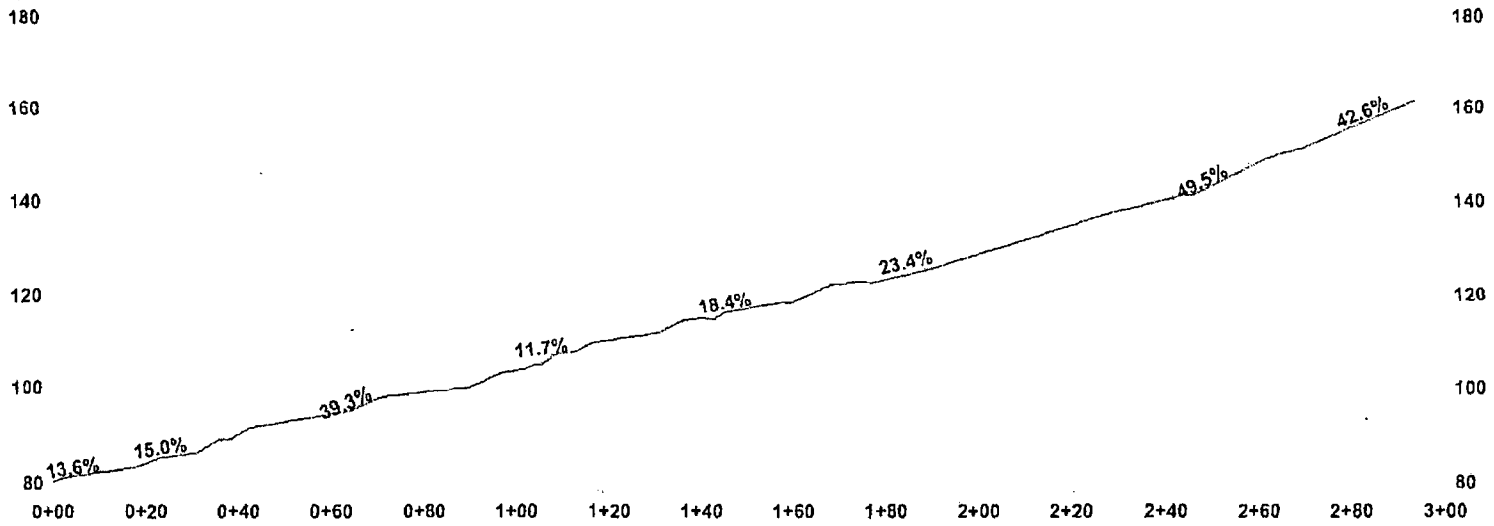
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

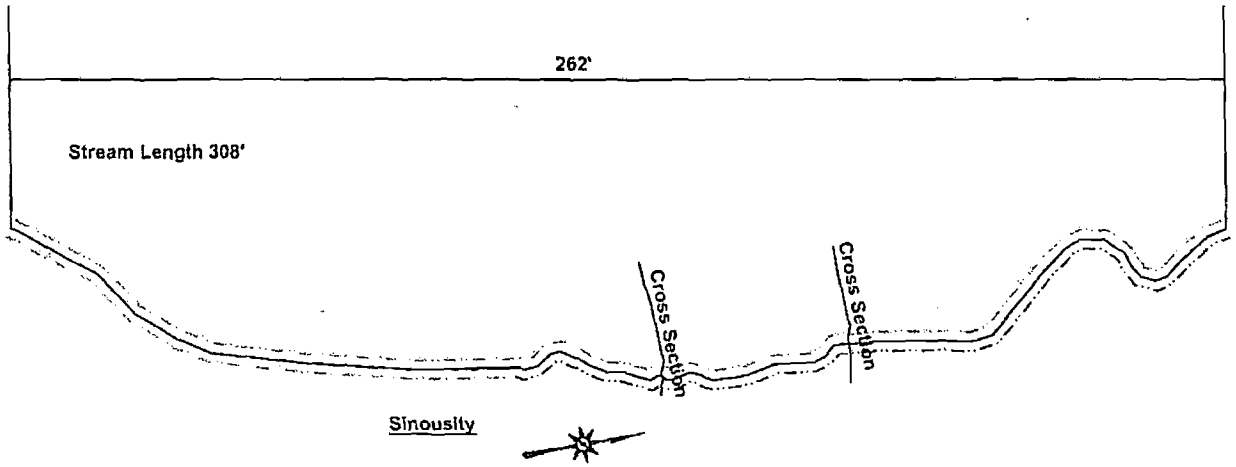
NALLY & HAMILTON ENTERPRISES, INC.

Longitudinal Profile
of Pond 91-A6
Knott County, Kentucky.

SCALE:	1"=40'	1/11/06



Profile



Sinousity

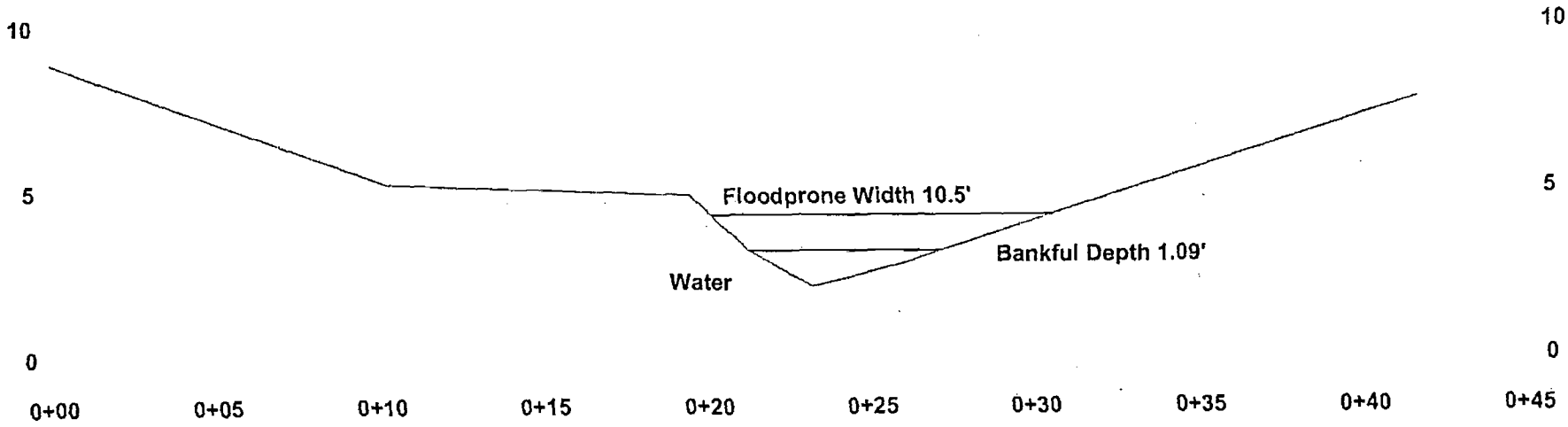
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Longitudinal Profile
of Hollow Fill 17-A6
Knott County, Kentucky.

SCALE:	1"=40'	1/11/06



Typical Section Hollow Fill 15-A5

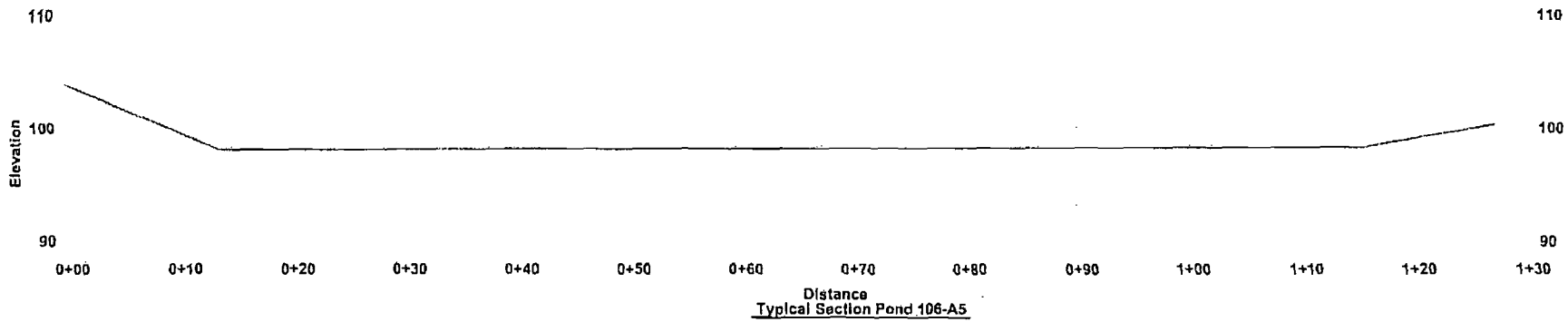
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Cross Section

SCALE: 1"=5' 11/15/05



Typical Section Pond 106-A5

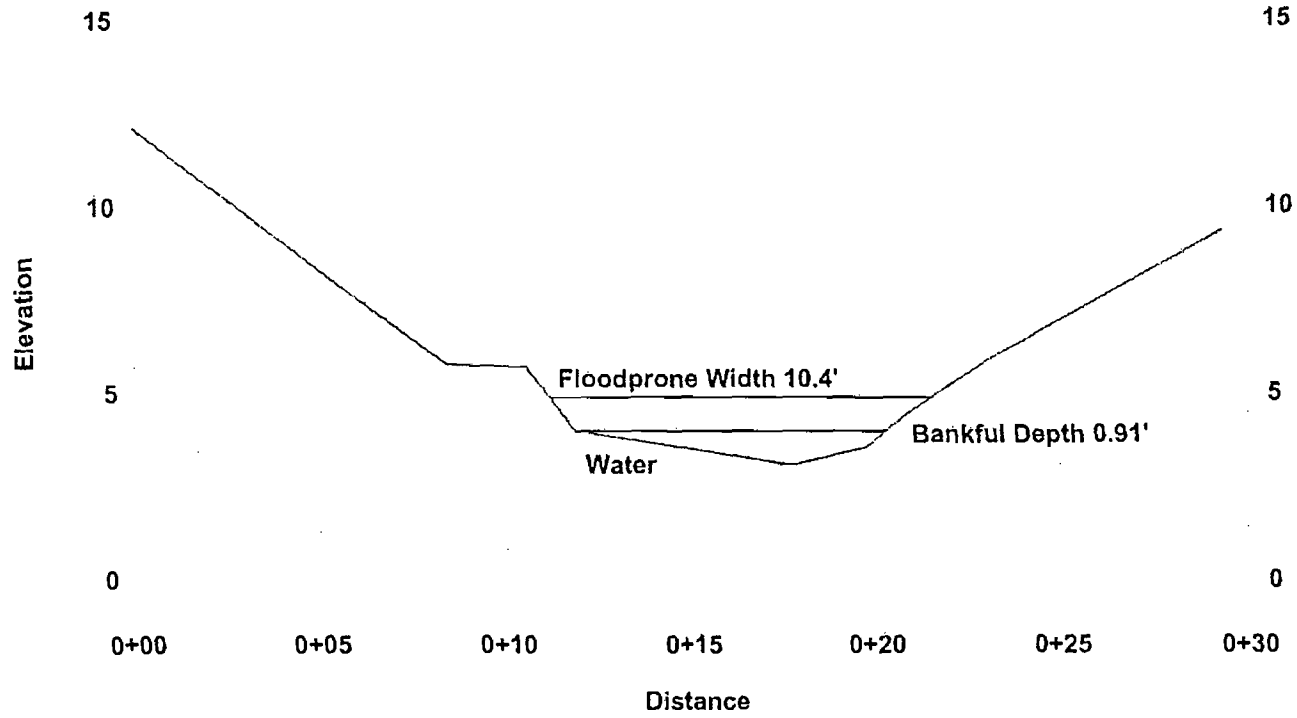
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Cross Section

SCALE:	1"=15'	1/11/06



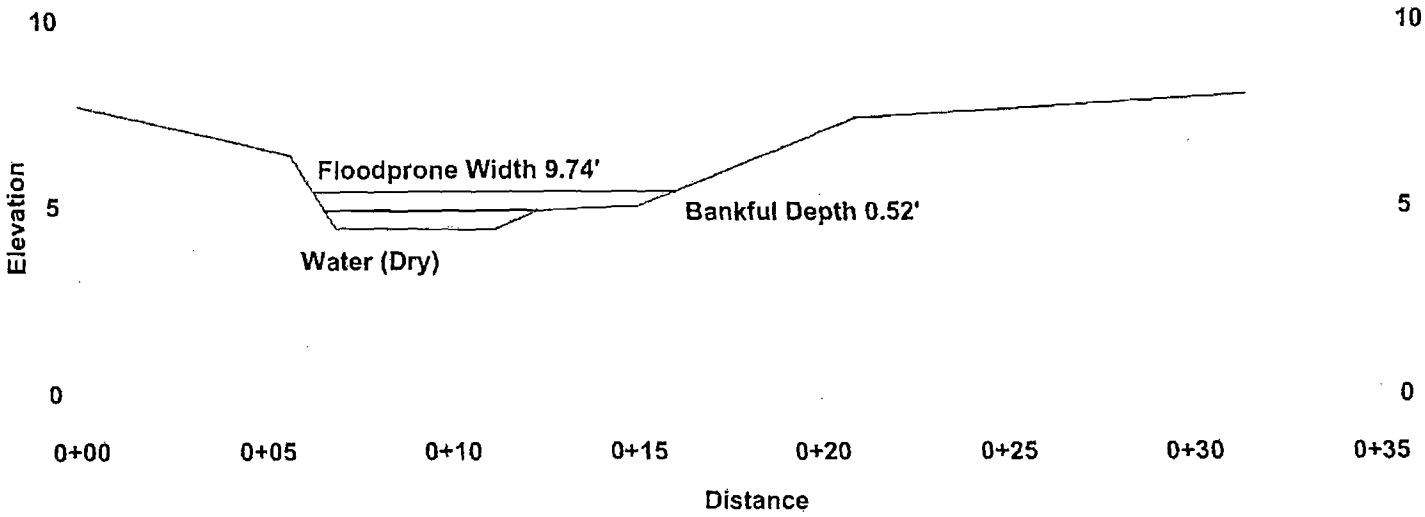
Typical Section Hollow Fill 16-A5

APOGEE
ENVIRONMENTAL CONSULTANTS, INC.
P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Cross Section

SCALE: 1"=5' 11/15/05



Typical Section Pond 107-A5

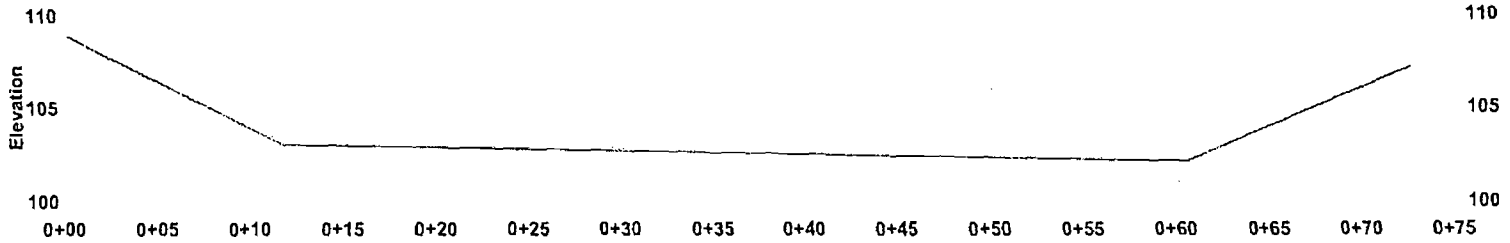
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES, INC.

Cross Section

SCALE: 1"=5' 11/15/05



Typical Section Hollow Fill 17-A6

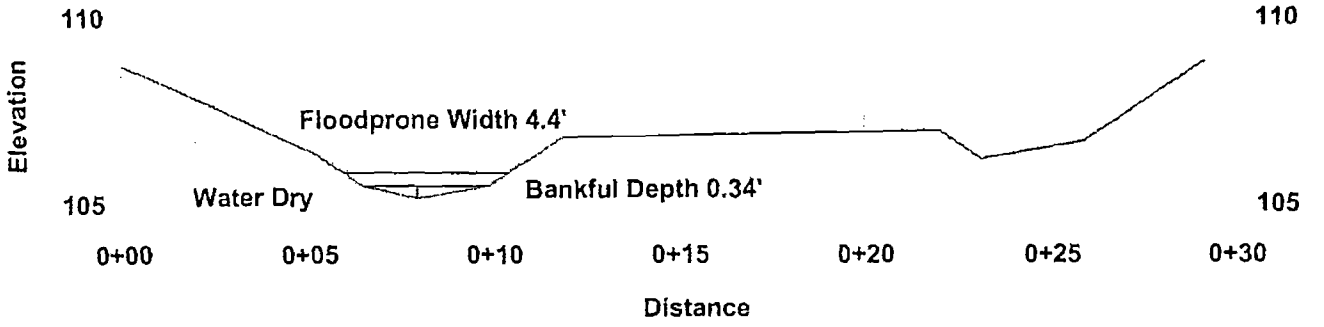
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

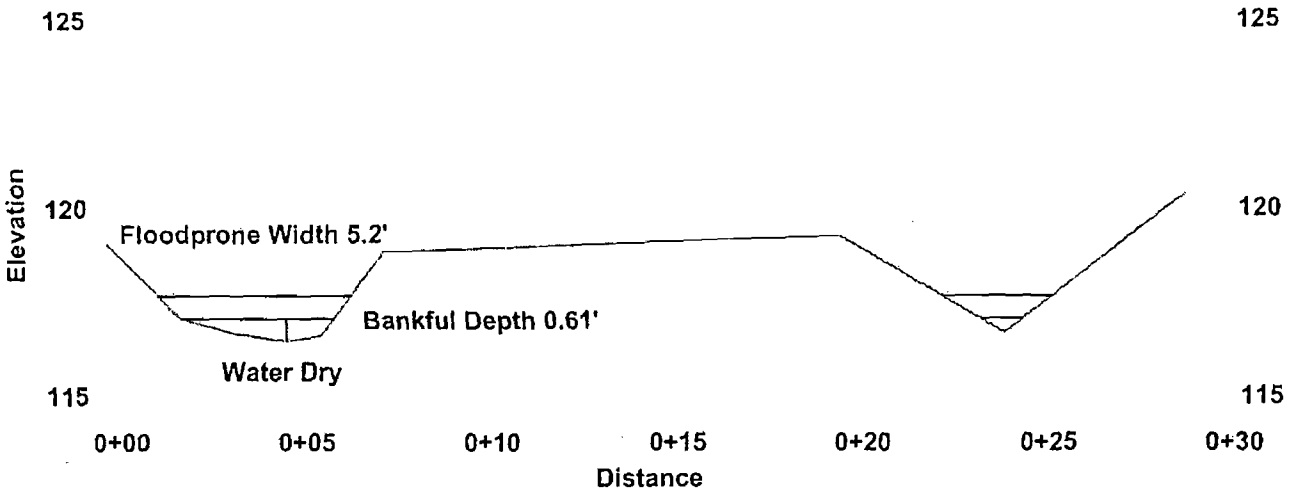
NALLY & HAMILTON ENTERPRISES, INC.

Cross Section

SCALE:	1"=15'	1/11/06



Typical Section Hollow Fill 17-A6 Riffle



Typical Section Hollow Fill 17-A6 Pool

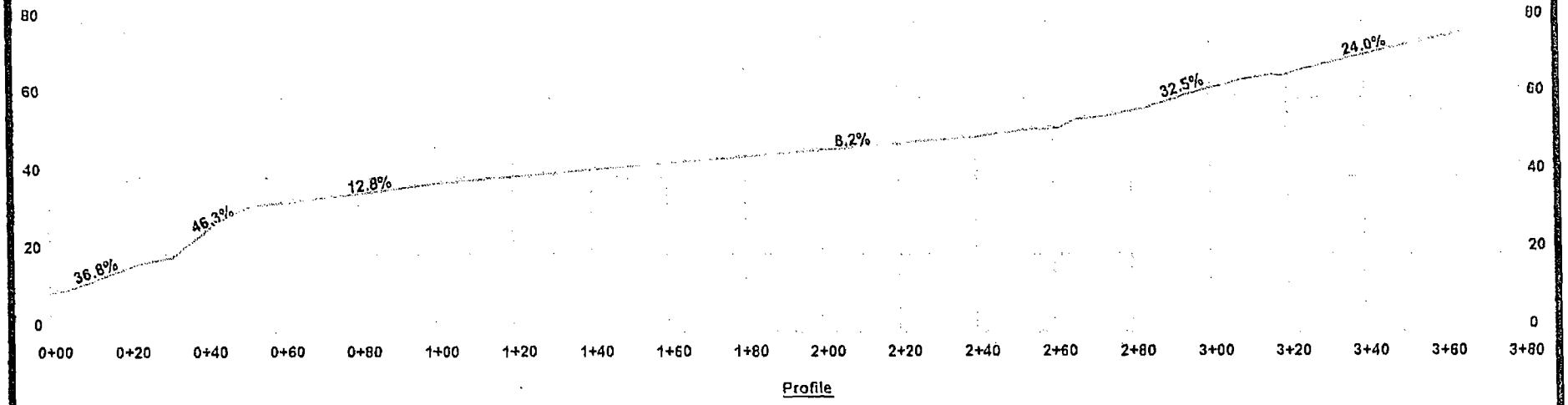
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

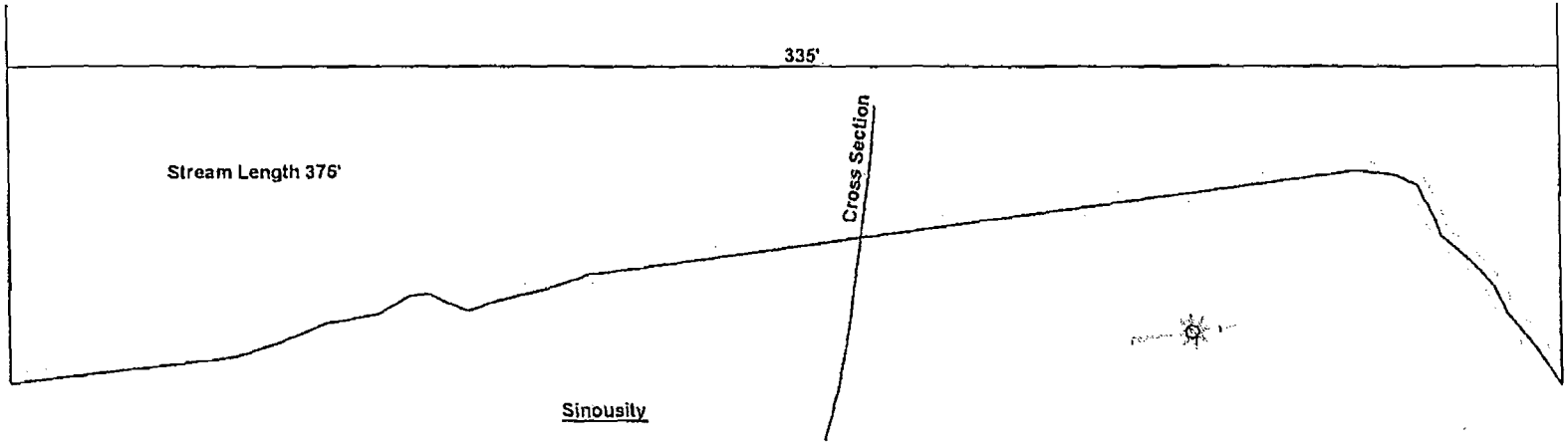
NALLY & HAMILTON ENTERPRISES, INC.

Cross Section

SCALE: 1"=5' 1/11/06



Profile



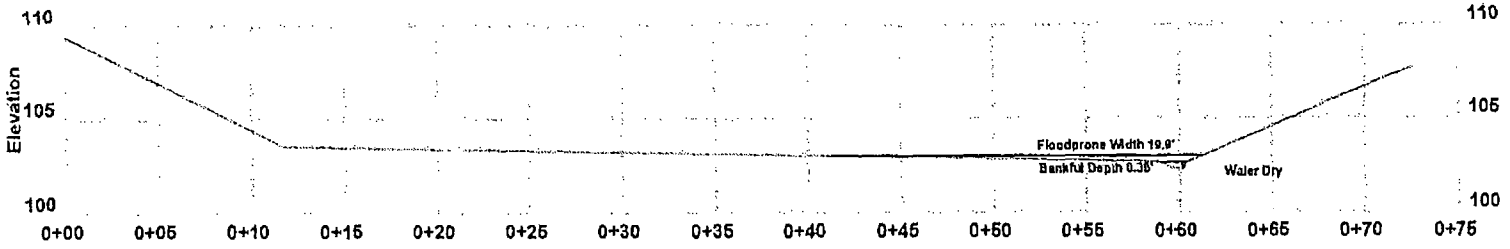
APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES

Attachment 5. Longitudinal Profile
of Pond 92-A6
Knott County, Kentucky.

SCALE: 1"=40' 1/11/06



Typical Section Pond 92-A6

APOGEE
ENVIRONMENTAL CONSULTANTS, INC.

P.O. Box 338 Tel: (606) 633-7677
Ermine, KY 41815 Fax: (606) 632-2626
Email: joelbeverly@hotmail.com

NALLY & HAMILTON ENTERPRISES

Cross Section
Amendment 5

SCALE:	1"=15'	1/11/06

Stream Channel Classification (Level II)

Stream NAME: UNNAMED TRIB TO DEFEATED CREEK

Basin NAME: HF 15-A5 Drainage AREA: 50.6 acre _____ mi²

Location: CARR FORK LAKE

Twp: _____ Rge: _____ Sec: _____ Qtr: _____ Lat: _____ Long: _____

Observers: _____ Date: 11-10-05

Bankfull WIDTH (W_{bkf}) 5.92 Feet
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 0.68 Feet
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf}=A_{bkf}/W_{bkf}$)

Bankfull Cross Section Area (A_{bkf}) 12.29 Feet²
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

WIDTH / DEPTH RATIO (W_{bkf}/d_{bkf}) 8.71 Ft/Ft
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{maxbkf}) 1.09 Feet
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 10.5 Feet
Twice maximum DEPTH, or ($2 \times d_{maxbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.

Entrenchment Ratio (ER) 1.77 Ft/Ft
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa}/W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 _____ mm
The D50 particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) 20.5 Ft/Ft%
Channel slope = "rise over run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) 1.12
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/ S).

Stream Type _____

For Reference, see page 5-5, 5-6: Rosgen, 1996. Applied River Morphology.

APOGEE ENVIRONMENTAL CONSULTANTS, LLC

Pebble Count Data Sheet

Project # _____ **Project Name** 860-0380 ADM PS

Stream/Drainage UNNAMED TRIB DEFEATED CK **Date** 11-10-05

GPS: N 37°13'50.7" **W** 83°01'58.1"

County KNOTT **State** KY **Quad** BLACKEY

Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)	Point (m)	Pebble size (mm)
0	152	26	12	52		78	
1	42	27	76	53		79	
2	5	28	22	54		80	
3	204	29	1700	55		81	
4	444	30	326	56		82	
5	213	31	178	57		83	
6	32	32	35	58		84	
7	1	33	89	59		85	
8	SILT	34	14	60		86	
9	45	35	SILT	61		87	
10	293	36	213	62		88	
11	11	37	66	63		89	
12	445	38	17	64		90	
13	32	39	86	65		91	
14	24	40	46	66		92	
15	3	41	525	67		93	
16	102	42	SILT	68		94	
17	34	43	634	69		95	
18	86	44	78	70		96	
19	78	45	1100	71		97	
20	40	46	98	72		98	
21	489	47	163	73		99	
22	172	48	95	74		100	
23	BOULDER	49	794	75			
24	28	50	32	76			
25	SAND	51		77			

APOGEE ENVIRONMENTAL CONSULTANTS LLC

Longitudinal Profile Data Sheet – HOLLOW FILL 15-AS

Project # _____ **Project Name** 860-0380 AOM #5

Stream/Drainage UNNAMED TRIB DEFEATED CK **Date** 11-10-05

GPS: N 37° 13' 50.7" **W** 83°01'58.1"

County KNOTT **State** KY **Quad** BLACKEY

Point	Distance from Beg(ft)	Elevation (ft)	Stream Characteristic	Water depth (Tenths)	Bankfull (Tenths)
1	0	72.0	RIFFLE	DRY	
2	9.7	72.0	POOL	↑	
3	15.1	73.9	RIFFLE	↓	
4	26.6	76.9	RIFFLE	DRY	5
5	35.4	78.0	POOL	4"	
6	43.7	80.6	RIFFLE	DRY	
7	53.5	82.0	POOL	2"	
8	63.9	85.1	RIFFLE	DRY	
9	72.2	87.9	RIFFLE	↑	
10	75.6	88.3	POOL		
11	83.0	93.8	RIFFLE		6
12	92.5	94.2	RIFFLE		
13	100.0	97.3	RIFFLE		
14	115.1	97.3	POOL		
15	127.5	99.1	RIFFLE		
16	138.9	100.9	RIFFLE		
17	142.6	101.3	POOL		
18	153.0	102.9	RIFFLE		
19	154.4	103.2	POOL		
20	175.7	104.5	RIFFLE		
21	182.0	108.3	RIFFLE	↓	
22	191.7	109.8	POOL	DRY	6
23					
24					
25					
26					
27					
28					
29					
30					

Apogee Environmental Consultants, LLC
P.O Box 338, Ermine, KY 41815 (606) 633-7677

APOGEE
ENVIRONMENTAL CONSULTANTS, LLC

Cross Section Data Sheet - HOLLOW FILL 15-A5

Project # _____ Project Name 860-0380 ADM #5

Stream/Drainage UNNAMED TRIB OF FAIED CK Date 11-10-05

GPS: N 37° 13' 50.7" W 83°01'58.1"

County KNOTT State KY Quad BLAKEY

Feature Surveyed [X] riffle [ ] pool

Point	Distance from LB (ft)	Elevation (ft)	Description
1	0	104.2	HILL
2	10.25	100.5	BOTTOM OF BANK
3	19.46	100.2	TOP OF BANK
4	21.28	98.5	BANKFULL/CHANNEL
5	23.22	97.4	THALWEG
6	26.11	98.1	CHANNEL
7	30.94	99.7	TOP OF BANK
8	41.70	103.1	HILL
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Stream Channel Classification (Level II) ...

Stream NAME: SUGAR BRANCH

Basin NAME: HF 16-A5 Drainage AREA: 56.5 acre _____ mi²

Location: CARR FORK LAKE

Twp: _____ Rge: _____ Sec: _____ Qtr: _____ Lat: _____ Long: _____

Observers: _____ Date: 11-10-05

Bankfull WIDTH (W_{bkf}) 8.44 Feet
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 0.55 Feet
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf}=A_{bkf}/W_{bkf}$)

Bankfull Cross Section Area (A_{bkf}) 4.2 Feet²
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

WIDTH / DEPTH RATIO (W_{bkf}/d_{bkf}) 15.35 Ft/Ft
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 0.9 Feet
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 10.4 Feet
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.

Entrenchment Ratio (ER) 1.23 Ft/Ft
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa}/W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 _____ mm
The D50 particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) 18.9 Ft/Ft%
Channel slope = "rise over run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) 1.04
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/ S).

Stream Type

For Reference, see page 5-5, 6-4: Rosgen, 1996. Applied River Morphology.

Stream Channel Classification (Level II)

Stream NAME: SUGAR BRANCH

Basin NAME: POND 107-AS Drainage AREA: 70.9 acre _____ mi²

Location: CARR CREEK

Twp: _____ Rge: _____ Sec: _____ Qtr: _____ Lat: _____ Long: _____

Observers: _____ Date: 11-10-05

Bankfull WIDTH (W_{bkf}) 5.74 Feet
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section.

Mean DEPTH (d_{bkf}) 0.39 Feet
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section. ($d_{bkf}=A_{bkf}/W_{bkf}$)

Bankfull Cross Section Area (A_{bkf}) 2.48 Feet²
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

WIDTH / DEPTH RATIO (W_{bkf}/d_{bkf}) 14.72 Ft/Ft
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) 0.52 Feet
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section.

WIDTH of Flood-Prone Area (W_{fpa}) 9.74 Feet
Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.

Entrenchment Ratio (ER) 1.69 Ft/Ft
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa}/W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 _____ mm
The D50 particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) 4.0 Ft/Ft %
Channel slope = "rise over run" for a reach approximately 20 - 30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) 1.34
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/ S).

Stream Type _____

For Reference, see page 5-5, 6-6: Rosgen, 1996. Applied River Morphology.